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CHEMICAL & METALLURGICAL ENGINEERING

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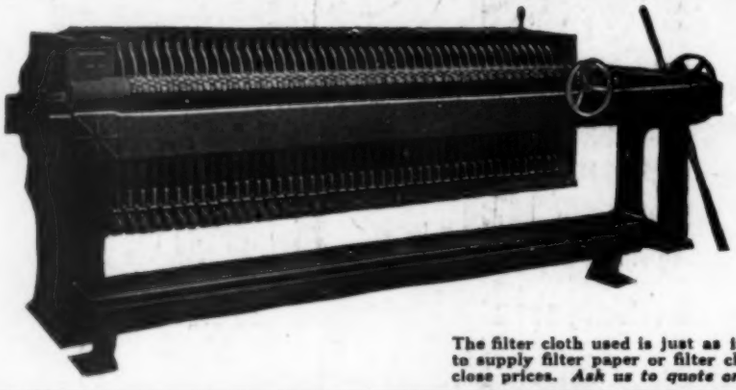

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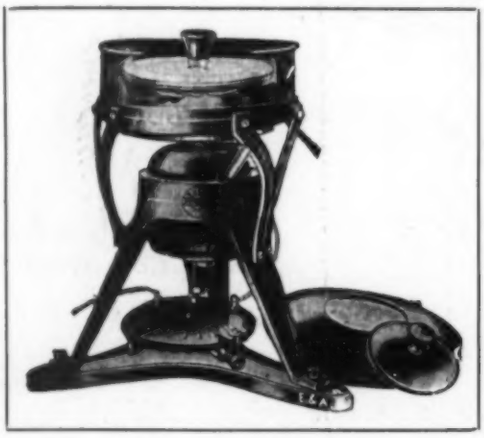

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

Volume 28 — New York, March 28, 1923 — Number 13

The Top Of the Hill

ANY one who has driven an automobile knows that an approach to the top of a hill at high speed on the wrong side of the road is dangerous. In the business world the same thing applies, and several traffic officers have stationed themselves on the business hill which has been climbed so rapidly and successfully during the past 18 months, warning traffic to keep to the right and to travel at a reasonable speed. These three officers are no less important persons than the Secretary of Commerce, the vice-president of the National City Bank, and the Federal Reserve Board.

Business always drives a strange road. No one can foresee, especially when on the upgrade, what will be over the top of the hill. In fact, long-time business forecasts are always impossible because the fog on the road conceals everything over a few weeks, or at most a few months, ahead. When we are going down hill we always know that there will be an upgrade when the bottom is reached. On the downgrade the brake pedal and the brake lever are vigorously used, especially if the grade be steep; but on the climb, business is inclined to "step on the gas" and go as fast as possible in the hope that higher levels of business may produce wide and pleasing views, green with the currency of large profit.

Right now clear-thinking business men who view the national situation broadly see that the high speed in increase of business forecasts an arrival at the top under conditions that may not be altogether safe. The top will be reached inevitably with a limit of the buying and consuming power of the public, supplemented by such exports as disturbed foreign conditions may permit. Careful appraisal of the situation indicates that the top of business activity is not very far ahead. The sign "Go Slow" is, therefore, a very important warning.

In two cases the warnings referred to above have been against excessive building activity. The Secretary of Commerce urges that the federal, state and municipal construction work now going forward actively be postponed somewhat in order that it may be used to fill in the hollows that inevitably will come later. This sort of leveling up of the business highway is an untried method of road grading, but it may prove to be a highly satisfactory one. The Federal Reserve Board evidently thinks well of the Secretary's proposal, for it too is contributing to the same end by delaying construction work under its control. Inevitably this will react upon banking agencies of all sorts, who will hesitate to finance additional construction unless it is very clear that it is imperative and that it can be done without unduly high costs.

The third traffic officer who has just placed himself on the business highway speaks from a prominent position as a representative of the Chamber of Commerce of the United States. This eminent banker would extend the warning against excessive construction work to include caution against excessive business inflation and undue expansion of credits in all lines.

When business comes with comparative ease, there is a great temptation to work one's credit facilities to the limit. However, the lesson of the disastrous consequences of that policy, as practiced in 1919 and early 1920, are still too clear in the minds of business to be forgotten. Business confidently expects that as the top of the grade is reached, it will be found that it is a plateau of successful and stable business which has been reached, not simply another sharp peak in the up and down of the business cycle.

If all branches of business will travel on their own side of the road and keep the pace of the crowd, there is no reason to believe that they will not arrive safely at the crest. But spurting ahead, especially attempting to pass just before reaching the top of the grade, will be bad practice.

The Power Outlook And Chemical Industry

THE power supply situation is certain to undergo great changes during the next decade. These changes, foreshadowed last year in the Superpower Survey, are well evidenced by the fact that the largest electric service corporations are studying all the available sources of hydro-electric generation, with a view to supplementing the output of their steam-electric generating plants with power made from "white coal."

The underlying reasons for this tendency are several. Outstanding is the well-recognized difficulty of providing transportation facilities for moving much more coal than the amount now consumed. Then again, the recent difficulties with labor in the coal fields make every coal consumer doubtful of the future continuity of fuel supply. Finally, the recent survey of the Bureau of Mines predicts the exhaustion within the next 50 years of all the good grades of steam coal mined in the eastern United States. This last is of great importance to all, for to raise steam with low-grade coal greatly increases the cost, and it is seldom economical to transport such coal any appreciable distance.

The recent widespread agitation for the development of the power of the St. Lawrence and the interest that New England manufacturers are taking in the development at La Grand Décharge at Lake St. John show where the public and most manufacturing interests look for relief from this coal situation. As predicted in the Superpower Survey, most electric power in the not distant future will be taken from long-distance high-tension transmission lines, fed from hydro-electric

plants, from the most favorably situated of the present existing steam-electric plants and from new steam-electric plants located at the mine-head.

The manufacturer in the chemical line may not see at first glance how these facts will affect him. The large needs of some chemical plants for process steam will undoubtedly make it economical for them to burn coal long after all other manufacturers have found it wise to resort to central station service. In fact, with the recent development of bleeder turbines, it may never be of financial advantage for such a plant to cease the use of coal to generate steam.

However, in many localities in Canada, such as Montreal, Three Rivers and St. Johns, and also in France, Italy, Switzerland, Norway and Sweden, it has been found worth while to generate steam by the use of electric-steam boilers. This because coal is difficult to get and is expensive, and there is a ready supply of high-tension current which can be cheaply had, especially at off-peak load periods.

It would be advisable for users of process steam in this country to investigate the methods used and the results obtained in Canada. For with the prospective development of high-tension distribution in this country, they may find it advantageous to follow the foreign example and place their full dependence on central station power.

A Wake Or Awake?

WHEN a gathering of technical men holds several simultaneous sessions, as is the habit of the American Institute of Mining and Metallurgical Engineers, it is obviously impossible for one person to attend all of them and appraise the relative interest manifest in the various subjects. However, the writer of these lines did sit through the recent sessions of the Institute of Metals Division (devoted to non-ferrous alloys) and those of the Iron and Steel Section. At the end of the meeting he could not help wondering, "What is the matter with the steel men?"

Looking back through the old volumes of *Transactions* you can find metallurgical classics from the pens of FRITZ, HOLLEY, HUNT and GAYLEY. Then after the mechanical revolution of 30 years ago came the interest in quality metals, exemplified by the new science of physical metallurgy. The keenest students turned their attention to this and during the decade from 1910 the *Transactions* bristled with micrographs and expositions of principles of heat-treatment by HOWE, SAUVEUR, JEFFRIES and BURGESS. Now the leader of these men has passed from us, the others have enlisted their interest in other societies or are publishing through more congenial channels. At any rate, any one having a lively remembrance of the discussions on "flakes" 5 or 6 years ago, a discussion which lasted all morning and broke out afresh and usurped a whole afternoon's program, views with sinking heart a meeting before which was dragged a specification for pig iron—already considered at length by other more interested organizations—and a resurrected paper on merchant bars, written from the 1900 viewpoint.

Of course it is unfair to expect an industry continually to put forth epoch-making ideas and improvements. Perhaps the steel industry has shot its bolt. But the American Society for Steel Treating continues to grow vigorously and hold monthly meetings in thirty different places. And in the Institute itself a smaller group of men, representatives of the poorly organized industry made up of hundreds of little brass and bronze foundries overloaded with hoary traditions and archaic methods, is able to maintain interest and even prepare a feature program.

The life seems to have gone out of the steel men. To see them sit around, after the best fashions among manufacturing chemists, with trumpets to their ears and padlocks on their lips, one would think that they have either reached the summit of absolute perfection or that they have no ideas whatever. Even when an excellent and suggestive paper on dirty steel is read, their silence is intense. One might imagine they had never seen such an animal, or if they had, had promptly nailed its skin on their barn door.

"We protest," say the steel men, "that our silence should be so interpreted. We are experimenting continually, and considering ways and means to improve our product. We have conference after conference for just that thing." But isn't it about time you were getting together in some sort of organization, somewhat extraterritorial? where the men from the big plants can rub elbows with those from the little independents—swap ideas and devise ways and means of warding off the demands of these pestiferous steel treaters, even if it is necessary to find out how to give them what they want. "Why, you know that 6 months ago a man in New England started to investigate his tool failures with hot acid, and today a fellow as far away as St. Louis is demanding 'hot etch' in his specifications! This thing has got to stop!"

Well, get together and stop it. But between you and me, it will not be stopped by a conference in the Carnegie Building, one of those meetings at the Commodore Hotel where Judge GARY rises and says "Gentlemen, I see no reason to doubt the future," or such a wake as the recent A.I.M.E. steel session.

Have You Obtained Your Engineer's License?

NO MATTER what one may think of the policy of licensing professional engineers, the fact remains that over half of the states have laws now on their books requiring that such licenses be obtained. In some states these laws are already in operation. In others the date on which they become operative is not far off. In New York State, for instance, the law takes effect May 5, 1923; and after that date no engineer may engage in the active practice of his profession unless he is licensed.

In view of the almost universal lack of knowledge of license laws among engineers we are printing elsewhere in this issue a résumé of license conditions in twenty-five states, together with the sections of the New York State laws that are of greatest interest to those about to apply for license. In this connection, the New York State law is among the most severe in requirements. Many other states accept the same or lesser qualifications as evidence of fitness to practice. Between many states there is reciprocity so that engineers licensed in one state may practice in another without obtaining a new license.

We advise those of our readers who are soon to be affected by these laws to read over the requirements of New York State carefully and then take care of this new obligation lest neglect should interfere with the conduct of their work.

Co-operation on Industrial Alcohol

A GROUP of representatives of the chemical, drug and related industries interviewed the Commissioner of Internal Revenue recently regarding industrial alcohol. The serious problem imposed upon industry by the restriction of this much maligned industrial chemical was clearly set forth, and the Commissioner was asked to establish a separate industrial alcohol unit in his bureau or, as an alternative, to appoint an advisory committee to assist in formulating rules and solving problems.

A very happy solution is now in sight. Commissioner BLAIR tentatively accepts the idea of a committee of ten members to work with his bureau. It will include wholesale and retail druggists, manufacturers of flavors, extracts, toilet goods and pharmaceuticals, chemists and business men acquainted with the problem from the point of view of both producer and user.

The appointment of such committee in the very near future seems assured. It is to be hoped that nothing will delay its appointment and its aggressive effort to straighten out the present snarl. A mutual understanding certainly could clear the atmosphere of much of the sulphurous language which has been incited by past proceedings.

The Civic Aspect Of Chemical Industries

CITIES in this country have been growing like weeds for the past 10 years. Most, if not all, have grown faster than is good for them; too fast to allow for the proper planning for beauty, for wholesome and economical living, and for the general welfare of their citizens.

Of the hundred cities that have grown most rapidly during the decade from 1910 to 1920 it is reported that increase in population has been principally due to the following causes: 13 on account of the automobile industry, 8 to the discovery of oil or gas in the neighborhood, 10 are suburban towns drawing their people from the overflow of larger cities near by, 18 to iron and steel, 7 to climate, hotels, boarding houses and facilities for health recovery and for amusement, 10 to cotton and cotton manufactures, 9 to the production of foods, 8 to lumber, and 17 attribute their rapid growth to reasons that are indicated as "scattering."

Although the production of iron and steel and the preparation of foods are essentially chemical industries, they are not generally so classified, and for the purpose of our thesis we shall confine ourselves to those industries generally recognized as chemical. What is it, then, that chemical industry does for the community in which it establishes itself? Of all the cities mentioned in the census report Wilmington, Del., is probably the only leading chemical producer among those recorded as "scattering," and we must bear in mind that during the war Wilmington was also very active in shipbuilding.

Chemical industries do not employ a large number of laborers in proportion to the capital invested or the value of the output. It is rare indeed that as such they add largely to the population of a town. And yet, of all the larger producing organizations, the manufacture of chemical products calls for the greatest proportion of technically trained men; of professional men as distinguished from business men and laborers. Aside from a few rustlers in the yard group, most of its laborers also need skill and intelligence. In other words, chemical industry does not often bring to town a vast number of hungry mouths to be fed. But it may, it often can and frequently does, bring *quality*. It brings a considerable influx of professional men, and these, with their scholarly training, are peculiarly desirable as citizens. Skilled workmen are also far more desired as citizens than so-called ordinary laborers.

So much for the advantages. The drawback is that too many chemical concerns maintain dirty backyards; some are offensive in general appearance, and not a few produce noxious fumes and odors as well as unsightly and often destructive wastes. Whenever it is possible to avoid these defects, chemical industry, properly administered, assumes a new civic rôle. With a clean, pleasant-appearing establishment that does not offend, with its large staff of professional men in control and research, who constitute a rare social asset, and its reliable and skilled workingmen, who contribute to the solidity of its people, a city is singularly fortunate in being the home of such an industrial organization. It gives it unusual attraction as a dwelling place. It does far more, in the long run, than the discovery of gushing oil wells in the neighborhood with the sudden millions, the inevitable gamblers, the cheap and short sports, and the collapse that is sure to follow the boom.

Chemical industry sometimes is and oftener may be the contributor of quality, of distinction, of straight thinking and of intellectual life to the city of its domicile.

More Complete Census Information

IN THE past the Census Bureau has reported its statistics on wood distillation in such form that one could not distinguish between the yields from hard and from soft wood. Recently a vigorous objection to this was voiced by one member of the industry and the matter was brought to the attention of the bureau by the editors of *Chem. & Met.* It proved to be a very simple matter to make an arrangement whereby these statistics can be divided to show the two branches of the industry separately.

There are doubtless other interests having similar difficulty with official reports. It is not always easy to use published data, valuable as they are. On the other hand, it is not always easy for the government statistician to understand the needs of industry. At all events, it is highly desirable for the industry and the investigators of such bureaus to understand each other most fully.

In discussing this particular detail with the Census it was found, as might well be expected, that the officials are very anxious to give the maximum possible service to the industries. The bureau obtains inadequate appropriations for some of its work, especially in the Census of Manufactures. But despite this condition, which is chronic with most government offices, the bureau reflects admirably the desire of Secretary HOOVER to make his department a real servant of business. *Chem. & Met.* has frequent occasion to confer with government officers and we find them almost invariably entirely reasonable and approachable. They cannot accomplish the impossible, although they are often in a position to do far more for an industry than is being done if they only know what is wanted.

Readers' Views and Comments

Magnesia as a Polishing Agent

To the Editor of Chemical & Metallurgical Engineering

SIR:—I should like to correct the misleading impression that one is likely to get from reading your article on "Magnesia as a Polishing Agent," page 441, March 7, 1923, which states that Dr. Rosenhain originated its use.

In my article on "Polishing Aluminum and Its Alloys for Metallographic Study," I gave credit to Hanson and Archbutt for introducing its use for polishing aluminum, because they made the first mention of it that I found in the literature. However, anyone reading the reference that I gave (*Inst. of Metals*, vol. 21, No. 1, 1919) would find in the discussion that Dr. Rosenhain stated that he had used the powder about 15 years previous, and would thus readily concede the distinction to him.

McCook Field,
Dayton, Ohio. E. H. DIX, JR.

The Nature Of Solid Solutions

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the article entitled "The Nature of Solid Solutions" which appeared in the Jan. 3 number of *Chem. & Met.*, a discussion of the crystal structure of the gold-copper solid solutions was introduced. Due to an error in computing atomic per cent from composition by weight, the inference was drawn that the alloys were more dense than their weighted atomic volumes would indicate. It was suggested that some extra attraction existed between unlike atoms which caused the

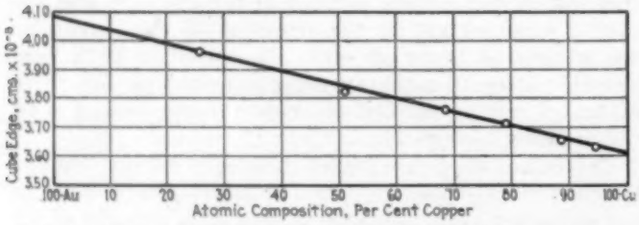

FIG. 1—SIZE OF FUNDAMENTAL CUBE IN THE COPPER-GOLD SOLID SOLUTION SERIES

dimensions of the unit cube of the atomic structure to be less than the atomic proportion would demand if no inordinate compression took place.

Recalculation of the atomic composition for the several lattice measurements produces the straight line function in the plot shown herewith which replaces Fig. 4 of the article. Copper-gold alloys therefore are like the copper-nickel, gold-silver, tungsten-molybdenum and other continuous solid solution series, and do not exhibit the overcompression of the solid solutions of pairs of metals which show limited solubility with formation of intermetallic compounds such as copper-zinc, copper-tin, copper-aluminum, silver-zinc and silver-cadmium.

It appears that the properties of the atoms which enable them to form intermetallic compounds also cause this attractive force when they are organized in the space-lattice of the solvent metal as well as in the compound lattice. And those pairs whose members are chemically similar and without what is sometimes called "chemical affinity" form the continuous solid solutions with no unexpected lattice shrinkage.

Cleveland, Ohio. EDGAR C. BAIN.

Intelligence Tests For Intelligence Testers

To the Editor of Chemical & Metallurgical Engineering

SIR:—You have recently devoted a little space to the consideration of educational matters, particularly the education of engineers, a subject naturally leading to the question, "What is an engineer?" You have also attacked that problem, at least to the extent of deposing and saying that to the best of your knowledge and belief the man who drives the boss to his work in the morning is not an engineer.

Perhaps, therefore, you will permit the observation that a neat definition of "engineer" and the widespread misuse of the word will neither be found nor prevented (respectively) until the officers of our technical schools, where "engineers are made," as it is said, make up their own minds on what is an engineer and what constitutes engineering. I have documentary evidence indicating this state of affairs, taken from the January number of the *Bulletin* of the Society for the Promotion of Engineering Education. Their committee No. 22, on intelligence tests, commenting on "the fact that the engineering profession is losing its identity," writes as follows:

"If a boy fails in machine design and in mathematics he may still become an engineer. It is only necessary for him to declare that he is a commercial engineer, a human engineer, that he can 'engineer' something that is non-technical. Suppose that a boy is considering engineering as his life work and that he has never had any interest in mathematics, physics, mechanics, machines, electrical devices, and tools. Should we advise him to stay out of engineering? That is a very real question. The boy might succeed in engineering anyway by choosing a course in administrative engineering. He does not need to worry about machine design and mathematics, because he is going to train himself to be a leader, the chief who *merely dictates to the ordinary engineer* what is to be done. [The italics are mine.] He wants to be the kind of engineer who is a leader in industry, not the ordinary kind of engineer who invents and designs and who solves problems that are scientifically intricate. He also has the option of becoming a sales engineer, with emphasis on sales. What can the vocational counselor do with such wonderful possibilities?"

What, indeed? I am dumb in the face of these overpowering thoughts!

Suppose a boy—your boy—on reaching college age was color blind, was a crack rifle shot, would go to sleep at a concert, was nauseated by interpretive dancing, could ski like a Norwegian, abominated Ben Hecht

and spent his spare time making puppets and breeding puppies. Should we advise him to stay out of art? That is a very real question, Mr. Editor!

If you were to ask my opinion, I should say that he certainly should by all means be an artist! One of that kind who spend from 10:30 to 1 o'clock in the Seventy-fifth National Bank behind the desk labeled "Chairman of the Board." A sort of sales artist, if I may coin the word, with emphasis on the sales. Let him be a leader, the chief who merely dictates to the ordinary artist what is to be done. Let him be *the leader*, not the ordinary kind of artist who communes secretly with the wise and beautiful and good, absorbs them into his soul and pours forth a vision of loveliness unthinkable, spreading its effulgence on this sordid world throughout the ages, and enrapturing all beholders with its majesty and godliness!

What can the vocational counselor do with such wonderful possibilities? My suggestion, Mr. Editor, is that they try to invent some intelligence tests for intelligence testers! MARTIN SEYT.

The Purposes Of a Standard

To the Editor of Chemical & Metallurgical Engineering

Sir:—Apropos of your editorial "The Purposes of a Standard" it occurs to me that as far as heavy chemicals are concerned the following points are worthy of consideration:

(1) Fixed standards will enable the buyer and seller to know they are talking about the same thing.

(2) Such standards should be an evolution inasmuch as they should arise from existing practices.

(3) In so far as the standards themselves are concerned they should not do more than record a specification. The improvement of specifications should arise from normal business. Enthusiastic people often write ideal specifications which unduly raise the prices of commodities. We have an example of this in the high candlepower standard of gas in the city of New York.

(4) Many individual specifications at the present time are somewhat, but not very far, different from a number of others. These differences might be brought together and such a movement would result in simplicity.

New York City. WALLACE P. COHOE.

Brittle Steel Evaporating Pans

Dr. T. Swinden read a paper before the Birmingham Metallurgical Society recently on "The Embrittling Action of Sodium Salt Solution on Mild Steel." As reported in *Engineering*, he stated that this type of failure was quite distinct from ordinary rupture arising from stressing beyond the normal static strength, or the fatigue type of fracture due to repeated or alternating stresses causing slip within the crystals. The embrittling action of certain salt solutions on mild steel was similar to the action of mercury and ammonium salts on stressed brass causing what was now generally known under the term "season cracking." The particular problem under discussion was the failure of mild steel plates forming the base of large evaporating pans operating upon mixtures of sodium and potassium nitrates. Whereas these pans lasted for many years without any abnormal failure when evaporating brine, trouble was immediately experienced when the nitrate solution was substituted for brine, and the failures were a matter of vital importance during the war period. Experiments showed that a steel plate laid loosely on the bottom of the pan was not deteriorated, while similar plates riveted in the pan in the ordinary way cracked. It was obvious, therefore, that stress was a necessary factor. However, since the action of nitrates was so distinctly different from that of chlorides, it was suggested that selective chemical action was the fundamental factor in producing "season cracking" in mild steel. The analogous case of the action of sodium nitrate was already well known. The speaker suggested that the embrittling action was due to an absorption in a state of solid solution of nitrogen or oxides of nitrogen from the nitrate solution by the material forming the intercrystalline boundaries.

Tin Ore Deposits

Tin is a difficult metal to mine and the known supplies in the world are limited. According to a report made to the Board of Trade, the output from the large alluvial fields of the Federated Malay States, which amounts to 30 per cent of the world production, has already begun to decline. In the Dutch East Indies and in Nigeria, supplying respectively 15 and 4 per cent of the total output, no expansion of the alluvial deposits is considered probable. Siam and China produce about 8 per cent respectively of the world output, but no large increase is looked for in either country.

Bolivia is the only tin-producing area besides Britain where a large output is obtained from lode mining and increased output there is dependent upon the price obtained for the product. Bolivia produces approximately 20 per cent of the total output of tin. Britain's contribution of metallic tin to the world's supply is under 5 per cent and is smelted from ore found in Cornwall and the adjoining part of Devonshire. Most of the mines, however, are faced with a decreasing yield from the ore mined and the position can be retrieved only by the discovery of new bodies of ore, which is possible but likely to be expensive.

El Dorado Oil Field in Arkansas

In a report recently issued by the United States Geological Survey, the results are given of an examination of drill cuttings from one of the wells in the El Dorado oil field. The examination enabled the geologists engaged in the work to subdivide the formations above the producing sand into ten zones, which can be distinguished by carefully watching the drill cuttings as the drilling progresses, so that the approximate position of the bottom of the hole with respect to the oil sand can at all times be known.

The lines of separation between certain of the zones are sharply marked. When the drill passes from the bottom of the Wilcox into the top of the Midway formation it goes from very sandy beds into beds that are only slightly sandy. The point of contact between the Midway and the Arkadelphia formation is also sharp and is easily detected, for at this point the drill passes from beds containing much sand and some limestone into beds that consist dominantly of shale or gumbo. The contact between the Wilcox and the Midway must be carefully noted, for oil or gas may be encountered anywhere below it, and a constant lookout for showings should be maintained after the Midway has been reached.

Casehardening Plant Timken Roller Bearing Co.

Timken Hardens Over Two Million Roller-Bearing Parts Daily —Special Furnaces and Quenching Machines—Slow, Mild Carburizer Used Exclusively—All Pyrometers of Platinum Wire—100 Per Cent Hardness Inspection on Cups and Cones

By E. W. Ehn
Metallurgist, Timken Roller Bearing Co., Canton, Ohio

IN THESE days when everybody owns an automobile of some breed or color—or cherishes a fond hope to buy one as soon as he can obtain the necessary credit —it is perhaps unnecessary to say very much about the way a roller bearing works. Bearings of this kind are found in every part of a modern automobile, front and rear wheels, differential, transmission, pinions, steering pivots, etc. It is not the intention here to enter into a discussion of the relative merit of the different types of roller bearings, or compare them to ball bearings, but in order to describe the metallurgical problems encountered in the manufacture of bearings it might be well to give a short description of the bearings. A typical Timken bearing is constructed as shown in Fig. 1. It consists essentially of an inner race or "cone" *A*, which slips tightly over the shaft, also an outer raceway, or "cup" *B*, that fits tightly into the wheel or bearing box. Placed between these two are a group of tapered rollers, *CC*, varying in number with the size of the bearing, properly spaced in a loose-fitting cage, *D*. By designing the cups, cone and rollers so that the apexes for the different surfaces coincide and fall on the center of the shaft, a true rolling contact is obtained without any sliding motion between the different members of the bearing. Ordinary tapered bearings will, therefore, carry a load on a line contact and will be able to take up a considerable thrust-load in addition to the normal load. By varying the angles the capacity for taking thrust-load and normal load can be regulated at will and suited for different applications.

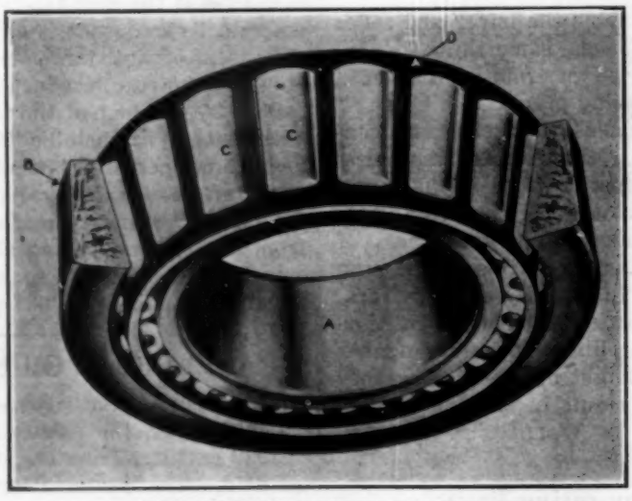

FIG. 1—ASSEMBLY OF TIMKEN ROLLER BEARING

Disregarding the cage, which will not be considered in this outline, all the cups, cones and rolls are made of casehardened low-carbon chromium steel of the following analysis:

	Cups and Cones Per Cent	Rolls Per Cent
Carbon	0.15 to 0.20	0.15 to 0.20
Manganese	0.45 to 0.60	0.45 to 0.60
Sulphur	Below 0.040	Below 0.040
Phosphorus	Below 0.040	Below 0.040
Silicon	0.15 to 0.20	0.15 to 0.20
Chromium	0.40 to 0.60	1.00 to 1.20

The superiority of the steel is not wholly due to the analysis of the steel used, but is also due to the electric furnace process employed for its making. The Timken plant includes a complete steel mill for making all tubes, bars and rods necessary for the production of the bearings. Steel is made in four 6-ton Heroult furnaces, and the fact that day in and day out the same steel is manufactured permits the workmen to become thoroughly proficient and to have a thorough knowledge of the requirements that must be met.

Laboratory tests, coupled with experience with more than 70,000,000 Timken bearings in service on all types of automotive apparatus and in mechanical and industrial machinery, prove that a bearing made from open-hearth steel will not give the performance and satisfaction of one made from a steel produced by the electric furnace. To prevent misunderstanding it must be mentioned that no claim is made that all open-hearth steel is bad. From time to time when making open-hearth steel, some heats will be as good as electric furnace steel, but for consistently good quality no steel can beat properly made and thoroughly deoxidized electric furnace steel.

Steel is made in the Canton plant from specially selected and analyzed scrap—50 per cent heavy scrap and 50 per cent turnings. After melting down, a test for carbon is made, and if too high some mill scale is added. The first, or dephosphorizing slag, is then rabbled off, the bath recarburized if necessary by coke, and the finishing carbide slag made up. Final adjustments of carbon and manganese are made by adding pig iron after the laboratory analysis has been received. Silicon additions are then made as indicated by forge tests, the furnace is tilted and the steel cast in molds about 5 ft. long and 16¾ in. square, set big end up and having a hot top. Special care is taken to insure a good surface on the ingot—the mold is washed with a solution of molasses and aluminum powder, the ingot remains undisturbed for 1 hour and is then moved

alongside the soaking pits, kept upright, and stripped only when ready to charge.

Ingots are forged into 8-in. blooms in a 625-ton press, cropped, cut in two and cooled. After chipping surface defects they are heated and rolled into useful sizes in a three-high 22-in. bar mill having tables which not only tilt but act as transfer tables as well. Bars from this plant are stock for automatic machine tools and forging machines. Some of the round bars are reheated and pierced in a Mannesman mill, and drawn to size for the caps and cones.

It will be noted that rolls contain a higher chromium content than the cups and cones. It will also be shown that the rolls are double treated after carburizing, as compared with a single quench for the cups and cones. This difference in practice is due to the fact that the rolls in a roller bearing, as well as balls in a ball bearing, must be the strongest part in the bearing. The experience with bearings on the road for more than 20 years, and with tests that have been conducted over a period of 10 years, show that if a bearing is overloaded, failure in service or in test will always be by failure of the rolls. If it were possible to make a better roll, it would consequently be possible to make a better bearing. Some years ago, when nickel steel was being used for rolls with more or less indifferent results, experiments were conducted by the Timken Roller Bearing Co. extending over 3 years and including thousands of bearings, both in the laboratory and on the road, in order to determine definitely the best steel for this part. A large number of steels were tested—chromium-nickel steels and nickel steels of varying percentages of chromium and nickel, tungsten, molybdenum and vanadium steels. Results clearly indicated that the high-chromium steel (1.0 to 1.2 per cent), such as used today in our bearings, was to be preferred to the chromium-nickel steels sometimes suggested for roller bearings. It also confirmed the standard practice in making ball bearings. High-chromium rolls showed the best resistance to wear, fatigue and shock of all the steels that were tried.

Test for Quality

It is outside the scope of this article to discuss the metallurgical details underlying the production of steel, interesting though such an account would be. Every 6-ton heat from our electric furnaces is checked for chemical analysis. In addition, tests are made on the suitability of the steel for casehardening purposes. This method has been developed at the Timken plant and has been the subject of several recent publications.[1] By means of tests of this kind it is possible unerringly to pick out a heat of steel which, while fulfilling all physical and chemical specifications, will possess a tendency to form "soft spots" in hardening. The tests are based on microscopical examination of carburized specimens and a special laboratory outfit working as part of the regular inspection is supplied for this work. Its success has been complete and similar tests are now used at a great many other factories doing considerable carburizing.

The different operations for conversion of the ingot in the steel mill into the proper sizes of forgings, tubes, hars and rods will not be described further. It is sufficient to state that the finished pieces, after proper inspection for size and physical defects (such as seams or laps), are moved to storage racks and from these delivered to the bearing factory according to requirements. By having the steel mill close at hand and subject to orders from the bearing factory, intimate contact and co-operation is maintained—a factor of extreme importance, as it facilitates not only a close control of the raw material for the bearings, but also makes it possible to produce on short notice any tube or bar required for special rush orders.

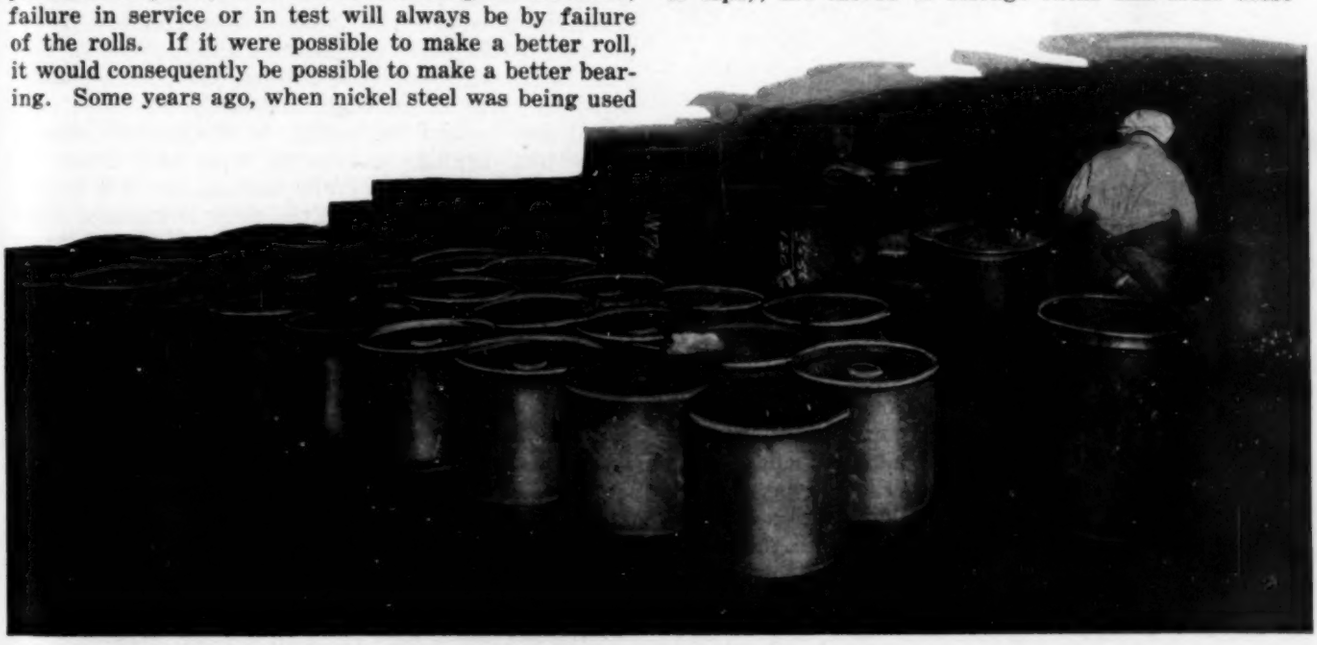

FIG. 2—A CORNER OF THE PACKING ROOM

After the various machining operations in the bearing factory, the "green" cups, cones and rolls are inspected for size, taper and finish, and flow in a steady stream to the carburizing department. The work arrives in properly tagged baskets and pans, and are trucked directly to the packing floor (Fig. 2).

Parts are packed in Nichrome containers with E. F.

[1] "Effect of Quality of Steel on Case-Carburizing Results," by H. W. McQuaid and E. W. Ehn, *Trans.* A.M.E., vol. 67, p. 341 (1922), abstracted in *Chem. & Met.*, vol. 28, p. 656; "Influence of Dissolved Oxides on Carburizing and Hardening Qualities of Steel," by E. W. Ehn, British Iron and Steel Institute, May, 1922, meeting; "Irregularities in Case-Hardened Work Caused by Improperly Made Steel," by E. W. Ehn, American Society for Heat-Treating, 1922, p. 1177 (September issue).

Houghton & Co.'s hydrocarbonated bone black, a compound composed of charred animal bones, charged with a hydrocarbon oil. Every carload of meal is checked before being released for production by special tests under operating conditions and the results must conform to rigid specifications. This compound is a carburizer of the slow type, nearly free from energizing chemicals and with a rather small grain size as compared to most other carburizing compounds. When dry or mixed one part new to three parts old, it flows very freely, which facilitates the packing and dumping of the pots to a considerable extent. The compound is rather heavy as compared with most other compounds, weighing 40 to 45 lb. per cubic foot, and has a comparatively slow heat penetration, but has, on the other hand, several advantages that offset these undesirable features. Shrinkage, even after 50 to 60 hours at heat,

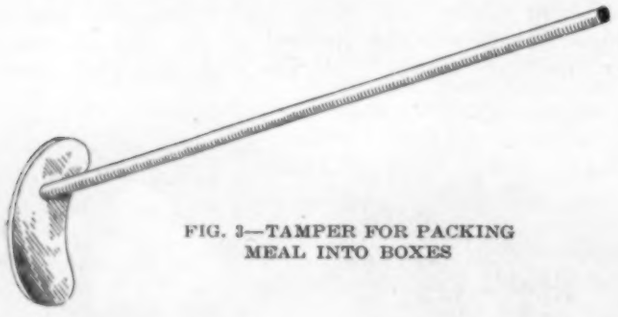

FIG. 3—TAMPER FOR PACKING MEAL INTO BOXES

is negligible and the compound retains its carburizing power practically indefinitely. On account of the slow penetration of carbon into the steel the danger of obtaining hyper-eutectoid cases is eliminated, a matter of extreme importance in the manufacture of roller-bearing parts, where an excessive amount of carbon in the surface would result in its chipping or flaking away and failure of the bearings would quickly result.

Most carburizers are of the rapid type, highly energized and having charcoal or coke as the base. Such compounds have a high shrinkage and lose their carburizing power after 10 to 15 hours at heat, when the energizing chemicals are exhausted. A compound of this type will give a heavy case in a comparatively short time, which of course is desirable from a dollars and cents standpoint, but on account of the almost inevitable variation in furnace temperature during the heating period, there will also be a very distinct tendency toward unevenness in carbon content and depth of case between the work in different parts of a single pot and the work contained in different pots. This may be all right for certain classes of work, but is distinctly not satisfactory when making roller-bearing parts where absolute control and evenness in the case is essential. With the slow carburizer and long time at heat, which features Timken practice, it will make no discernible difference if one pot should reach carburizing temperature slightly ahead of other pots in the furnace. The firing is, moreover, so regulated that there is a minimum danger in this respect.

The work is packed with bone meal into pots made of Nichrome, which alloy has been found to give very satisfactory service. This packing is done by hand by operators sitting in front of the pots with a pan of work on one side and a can of meal on the other. After spreading about 1 in. of meal in the bottom, a row of rings is laid in; this is barely covered with meal and smoothed down and patted in place with a little tamper such as is shown in Fig. 3. The usual practice is to pack the cones inside the cups of the same bearing and reasonable care is taken that the different parts do not touch one another. Two inches of carburizer is always provided at the top of the pot. Rollers are simply scooped into the pots in layers, and contrary to the usual experience in carburizing—that soft spots will be obtained in hardening if the parts touch one another—it has been found that no trouble is experienced in this respect. The reason for this doubtless is that with the long time at heat required by the Timken practice, the carbon has an opportunity to equalize by diffusion, which is not possible when, as in most places, a total time of only 4 to 10 hours is allowed in the furnaces.

Alloy Pots

Various shapes and types of pots have been used, but best results are obtained with round pots, such as shown in Fig. 4. The pots are considerably larger than the pots used in most other plants, and on account of the size and the slowness of heat penetration with bone meal, the pots are made with a 4-in. chimney in the middle. To facilitate the handling and to allow for heat penetration also from the bottom, the pots are made with stout legs 2½ in. high, and lately legs have been placed also toward the middle of the pots to prevent the bottom sagging. Covers are made with flanges fitting around the chimney and against the wall of the pot. After the pot is filled the cover is rammed down and the fit is close enough to eliminate the use of luting clay. This is one great advantage over steel pots, as when clay is used it is difficult to prevent dirt from getting mixed into the meal and afterward cause soft spots in the hardening operation. Eliminating the clay sealing also facilitates handling the pots and taking out the control samples. It can be mentioned that on the scale on which carburizing is carried out in the Timken plant a saving of two to three men's labor is obtained simply by eliminating this luting operation. Covers are made with flanges on both sides and are used indiscriminately with one or the other side up—this in order to avoid sagging and cracking around the flanges. We have tried other types of pots, of square or rectangular shape, but the sides of these containers warped and cracked badly, and with the exception of a few old pots, the use of this type has been discontinued. Steel pots have also been employed to some extent, but are no longer used. Besides having a short life they scale and warp badly, are very heavy, and heat penetrates slowly through the scaled surfaces. In spite of the lower price per pound, steel pots are in the long run more expensive per heat-hour, and require much more work for handling and sealing. Pots of other heat-resisting alloys than Nichrome have been tried, some with fairly good results, and some with results not

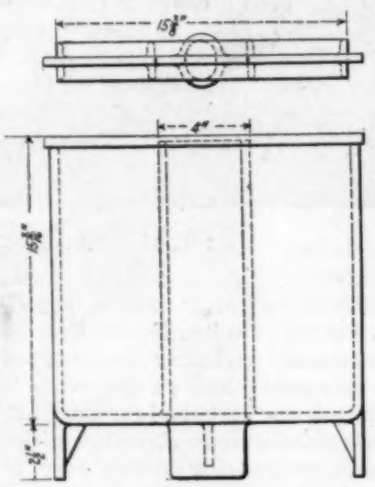

FIG. 4—NICHROME POT

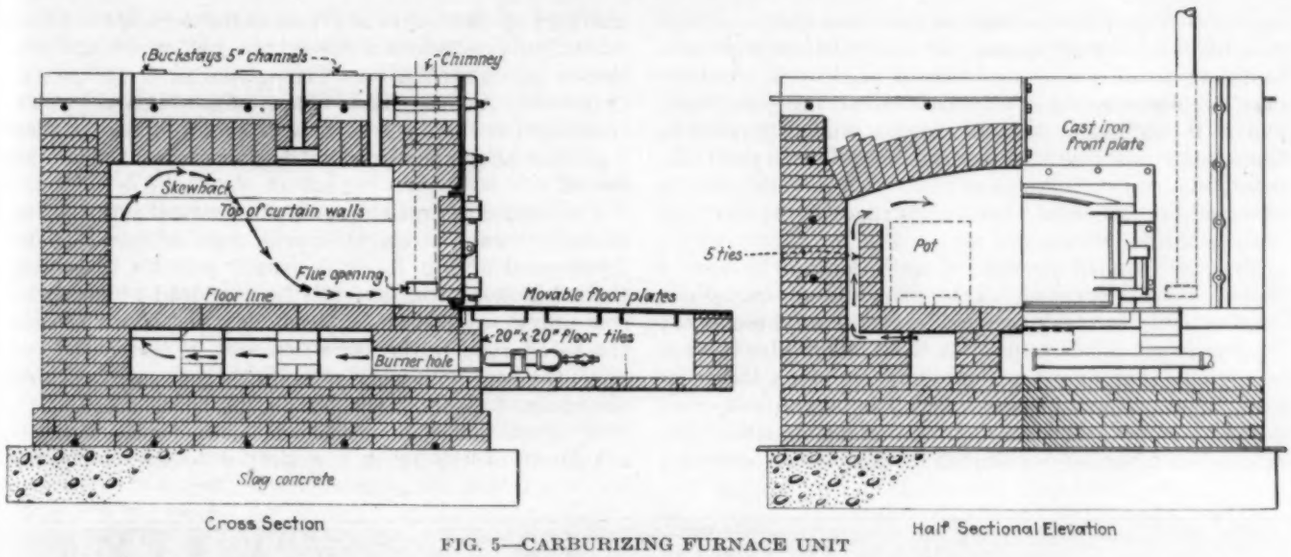

FIG. 5—CARBURIZING FURNACE UNIT

so good. As far as resistance to heat is concerned, several have been satisfactory, the trouble usually being that the legs break off due to a brittle metal and the rather rough handling to which the pots are exposed.

All Nichrome pots are guaranteed for a certain minimum time in service, and in order to keep track of the different pots large identification numbers are cast on the outside of each pot. The furnace hours for each pot are recorded on special sheets, and the time is computed for each pot four times annually. With about 1,500 pots in service, this is quite a job, but it is necessary and in fact pays for itself. The majority of the pots give much more than the guaranteed life, some still being in good condition after more than 10,000 heat-hours, but others, especially those of square design, have not given such good account of themselves. Most of the failures have been due to weak legs, which, however, has now been entirely overcome by an increase in section. Occasionally a pot must be discarded because it cracked around the chimney or developed holes in the sides or in the bottom, these latter defects probably being caused by segregations. However, the latter types of failures have been scarce. In this connection it might be mentioned that Timken practice presents exceptionally favorable conditions for alloy pots, what with slow heating, long heats and a compound containing no energizing chemicals. Rapid and repeated heating or cooling is naturally very damaging to pots of any kind, and it is well known that energized compounds containing cyanogen salts (and to a certain extent sodium carbonate) have a deteriorating influence on nickel-chromium alloys.

Carburizing Furnaces

The packed containers are heated in special furnaces to a temperature of 1,680 to 1,700 deg. F. and kept at this temperature for various lengths of time, depending on the depth of case required. Seventy furnaces, each with a floor space of 5x5 ft., are available, grouped in three blocks and built side by side and back to back, strongly bound together with rods and buckstays (Fig. 5). Such a construction obviously conserves the heat very well, since the individual furnaces radiate heat only through top, bottom and front. The door is a large iron casting hinged on one side and lined inside with a cement-Silocel mixture. It swings open quite easily, but can be held tightly shut by wedging against a cross-bar. When heat is on, all edges are carefully luted with clay. The furnaces are of the underfired type, with a hearth of flat tiles. These are supported by firebrick walls running from front to back, forming a labyrinth through which the flame and hot gases must pass, backward and forward, until they find their way out up the slots formed by the side walls and the vertical tiling set at the side of the hearth. In the furnace chamber the moving gases strike the arched roof, are deflected back down upon the pots, work their way forward and pass through low openings near the door into

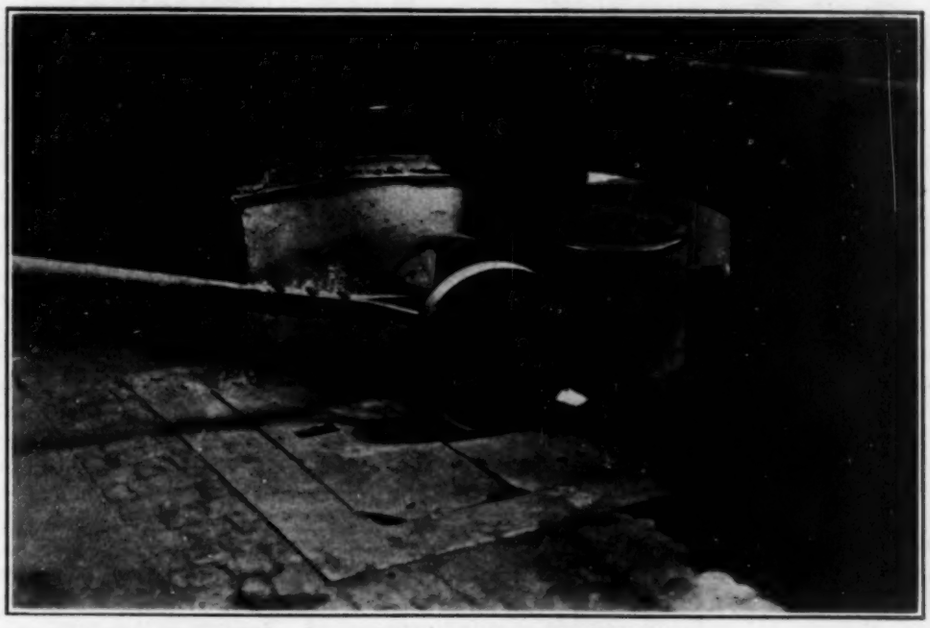

FIG. 6—REMOVING A HOT BOX

small exhaust chimneys built in both door jambs. With this method of heating and the construction of twenty to thirty furnaces in one block of brickwork, the temperature distribution in a furnace is extremely uniform, and it is very rare to note any material difference in the quality and depth of case in the different pots that constitute one furnace load. If such a difference is observed, it indicates that the furnace is burned out and should be rebricked.

Heat is supplied by one centrally located burner in front of each furnace. This principle of using one single burner for each furnace is, by the way, a distinct feature in all furnaces used in the Timken plant and it is obvious that firing is thus simplified to a large degree. Natural gas is used when this is available—i.e., during summer—and oil during the remainder of the year. Gas firing allows slightly better control and with the burners with dirt and coke. Burners are so made that they can be used for either gas or oil and connected up in such a way that a change from one fuel to another can be made on a minute's notice. The consumption of oil per furnace when up to heat is about 3 gal. per hour and somewhat higher during the heating period.

The loaded carburizing pots are charged into the furnaces by means of special trucks, such as shown by the foreground of Fig. 6. It is usually possible to arrange the schedule so that one full furnace load of nine pots, containing work that requires the same depth of case, can be charged in the same furnace. If this is not possible, the pots with work where a thinner case is desired are charged in front and later withdrawn ahead of the rest of the pots. In moving the pots forked tongs on the front of the truck are slipped under the bottom

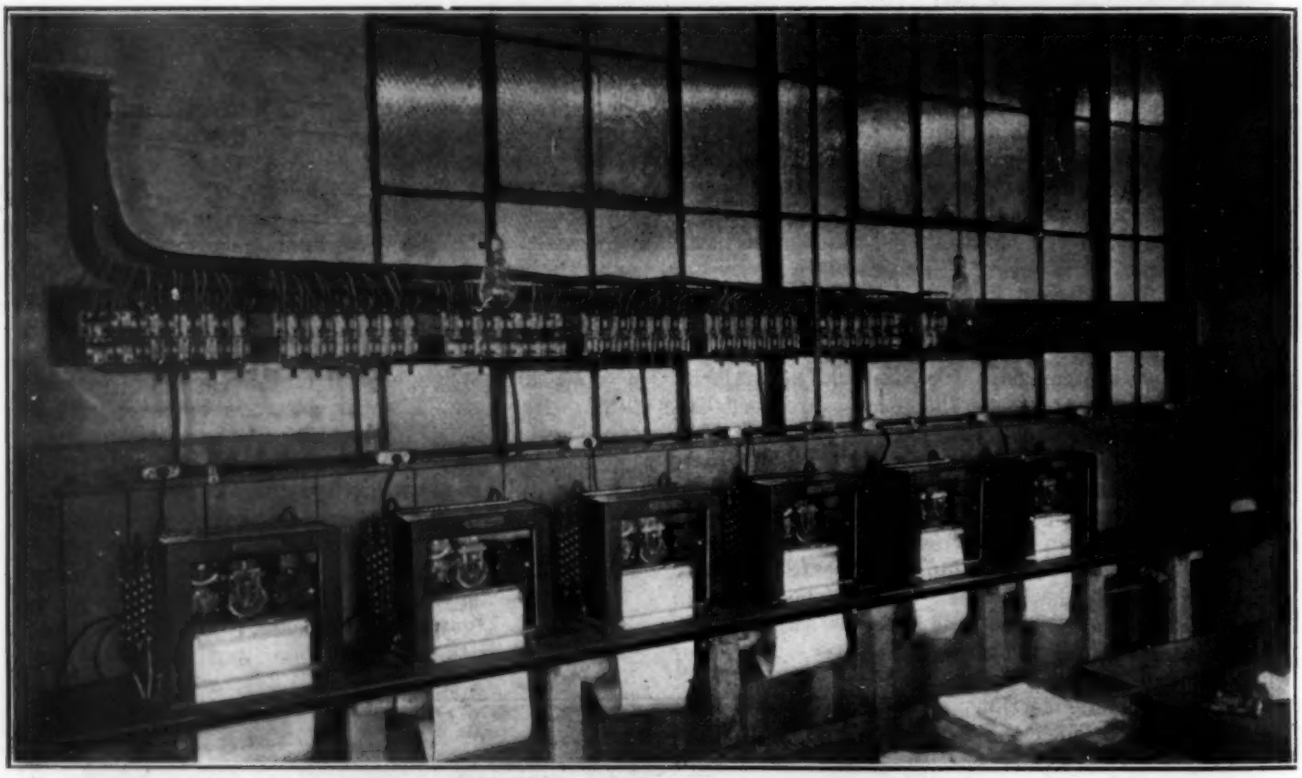

FIG. 7—BATTERY OF LEEDS & NORTHRUP RECORDERS

prevailing prices is cheaper, but is harder on the furnaces. A furnace on gas has to be rebuilt about twice as often as when using oil as fuel. In order to obtain proper results it is necessary that a high grade of light oil be employed, and every carload is therefore submitted to laboratory tests for residual carbon, fluidity and to other routine tests before it is pumped into the storage tanks. Oil is supplied to the furnaces through a circulating oil system—i.e., the oil pumps are so dimensioned that they will supply an amount of oil many times in excess of the consumption and the excess oil is carried back to the storage tanks. Pressure is kept constant by pressure regulators on the feed and return lines, the former adjusted to 60 to 70 lb. immediately beyond the oil pumps, and the latter to give 35 to 40 lb. immediately ahead of the discharge to the storage tanks. This system is much to be preferred to a dead-end system, as it facilitates an even adjustment of the oil pressure and has much less tendency to clog up of the pot, between the short legs, and the leverage provided by a long handle is great enough so that the operator can balance the 300 to 400 lb. weight of the loaded pots and move them around rapidly and with great ease. He can also reach into the far corner of the furnace without coming too close to the hot door. All the furnaces are built with their floors level with the aisles, which in turn are paved with cast-iron plates, and the charging or discharging of a furnace can, by means of these trucks, be done in from 5 to 10 minutes. When a charge has been drawn the hot furnaces are reloaded and sealed as quickly as possible. Some of the floor plates in front of the furnace are removed, opening the pipe trench and exposing the burner and its port hole. Control valves for fuel and air are located at handy places in front of the door jambs. Firing at the start is relatively brisk, so that the cold pots may not draw heat from the surrounding brickwork too rapidly and disturb the temperature in adjoining ovens. It is

desired that all charges be brought to heat in 10 hours, a time sufficient to insure that no great difference in temperature exists between the different pots and from center to outside of the individual pots. As previously noted, further assurance regarding the uniformity of the case is obtained by the use of a slow carburizer, and even if the work in one pot should be at effective carburizing temperature 30 minutes longer than the work in another pot, the variation in case cannot be measured.

It might be thought that fuel economy would demand quicker heats, but the construction of the furnaces is such that only 3 gal. of oil, costing about 6 cents a gallon, is required per hour for one furnace, and the extra cost for several hours' heat is compensated by the saving in labor from packing and handling the work in large pots and the greater regularity of the results obtained. It is quite true that more equipment and furnaces are necessary, but careful calculations in regard to the saving of labor cost show that the actual cost of carburizing by the Timken practice is not higher than though a faster carburizing process were used. Even if the cost should be higher, it would be many times repaid by the high and uniform quality of the casehardened work, which is absolutely essential for the parts in a bearing. Moreover, a few rejections at this stage in the operation would amount to more than the cost of the entire carburizing operation. It is not the intention to criticise in any way the practice for carburizing used at other plants, as it is realized that for many purposes faster methods and compounds can be used, but for the very accurate work necessary in making roller bearing parts, only a method such as outlined above will give satisfactory results.

Platinum Couples Used

Temperature in each furnace is measured by platinum thermocouples used in conjunction with indicating and recording potentiometers. The thermocouple is protected by a short quartz tube, extending through the arch at about the middle, and projecting down 3 in. into the furnace. The other (cold) end is surrounded by water jackets and with open discharge overflowing in front of the furnaces so that it can be instantly seen whether all cooling jackets are working properly. Thermocouples are welded to extensions of copper wire that are connected in the usual way by a double-wire system to mercury selective switches in the furnaceman's office and extend to the main pyrometer room. (Some years ago the usual system with a common return line to all thermocouples was used, but it did not prove satisfactory.) In the furnaceman's office individual readings by a potentiometer indicator are made and recorded for each furnace at 30-minute intervals. This record guides the fireman, and he constantly refers to it and adjusts each burner valve accordingly. The main pyrometer room holds the recorders (one battery is shown in Fig. 7) so that heating curves can be obtained on every heat, if a furnace load for one reason or another should not give the desired results.

It has been said that this installation of platinum couples with water-cooled cold ends is unnecessarily expensive, but careful calculations have shown that in the long run, in spite of the high cost of installation, this system does not cost more than the usual installation of base-metal couples. Our pyrometers last indefinitely; one man has no trouble in taking care of about 150 couples, checking them for accuracy once a month. The cost of maintenance is therefore very low as compared with other systems. Moreover, in this line of work, there is only one thing that counts—accuracy—and a few spoiled heats due to defective couples would pay for a very large part of the installation.

After reaching temperature, the furnace is held within 10 deg. F. plus or minus for a length of time, varying from 4 to 50 hours, depending upon the required depth of case. The shorter time will produce a case $\frac{1}{64}$ to $\frac{1}{32}$ in. deep, while the latter will give $\frac{3}{64}$ to $\frac{1}{16}$ in. penetration. The depth of case that can be expected after various lengths of time at heat has been carefully determined by experiments. In addition test specimens are packed in each pot, strung on a loop of wire, one end of which is hooked over the edge of the pot. When the time is judged right, the furnace is opened long enough to withdraw one pot, the samples are quickly extracted without disturbing the contents materially, water quenched and broken with a sledge. Visual examination after dipping in 10 per cent nitric acid indicates to the inspectors whether the desired depth of case has been obtained. If not, the pot is replaced, the furnace sealed and firing recommenced. After an appropriate time, a second pot is withdrawn and test specimens again quenched, broken and examined.

When a furnace load is approved by the inspectors, the pots are removed from the furnace and trucked to a cooling alley, where they stand in open air, requiring about 6 hours to reach 150 deg. F. From each pot is taken a sample of the work, which is reheated to 1,420 to 1,440 deg. F. in a small furnace, quenched in water and broken. After etching the fracture in 10 per cent nitric acid the depth of case may easily be estimated by the dark ring produced. Each individual pot is thus tested and the release is indicated by insertion of rods with attached tags of various colors, showing the nature of the work in the pot and giving instructions for further handling.

When the pots are thus released they are trucked over to a metal screen, No. 4 mesh, set flush with the floor, and dumped upside down. The meal sifts through the screen like dry sand, drops into a hopper, and leaves behind the various carburized parts on the screen. They can then be shoveled into pans and barrels for transfer to the hardening room. Meal is taken from the underground hopper by a screw conveyor and belt elevator to a closed storage bin. All these housings are connected to a suction exhaust and cyclone collector system, which is quite effective in keeping any dust from flying in the air. From the storage bin it is passed through a pug mill, fed automatically with three parts old and one part new meal. This drops into large containers, and these cans of carburizer are returned to the packing floor.

Hardening the Carburized Work

Hardening practice for cups and cones is different from that for rollers, and will therefore be dealt with separately.

Cups and cones are heated in specially designed rotary hearth furnaces, the general arrangement of which is shown in Fig. 8. It is 7 ft. in diameter, built like a turret with stationary side walls and roof, bound together with sheet steel. The moving hearth is annular and is covered with close-fitting segments of Thermalloy, a heat-resisting metal, resting on firebrick, which in turn is supported by a steel ring.

This flat ring rests on rollers, and has an annular rack attached to its lower surface, meshing with a bevel pinion, motor driven through a reducing gear and double speed changer. The speed of rotation can, through this arrangement and a system of double cones, be easily changed through a wide range, and the time for one revolution is so regulated that the parts will reach proper hardening temperature immediately ahead of the discharge door. For small work this time is 20 to 30 minutes and is increased to more than 1 hour for cups and cones of very large sections. The furnaces are heated by a single burner, centrally located, on top of the furnace.

The axis of the furnace—its "core," so to speak—forms a short combustion chamber from which the combustion gases, through slots, pass out radially into a second combustion chamber formed by the roof of the furnace and a false arch set about 5 in. lower. This lower arch has a series of fifteen long slots 3 in. wide equally spaced around the false arch except above the doors. The hot gases travel through the working chambers as indicated by arrows in Fig. 8, and escape through the front doors of the furnace. Of these there are two, the one to the left for charging and the other for removing heated rings after they have traveled around the furnace. By tilting the burner slightly it is possible to divert most of the hot gases to the side where the cold work enters the furnace, and this tends to equalize the temperature above the hearth.

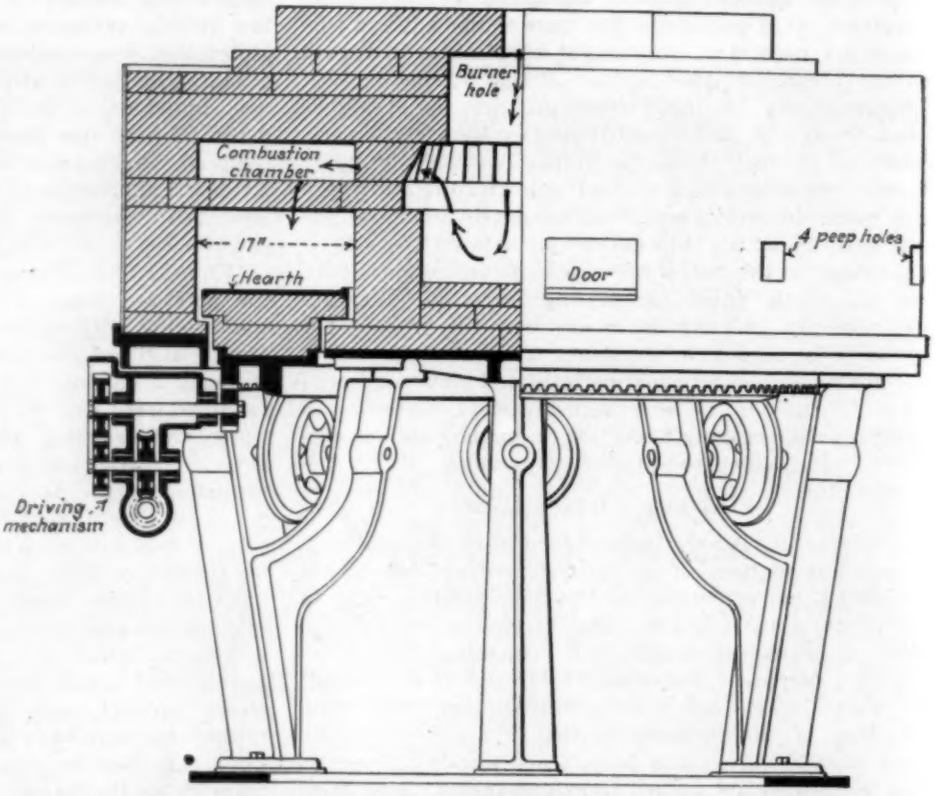

FIG. 8—SECTIONAL ELEVATION OF ROTARY HEARTH FURNACE

A pyrometer is inserted through the roof immediately ahead of the discharge door. Couples are made of platinum, as in the carburizing department, and are protected by short quartz tubes. The cold end temperature is kept constant by a cold water jacket on top of each furnace. Couples are connected through copper wires leading to a selective mercury switch with an indicating potentiometer and in addition to this the temperature of the furnace is checked on recording instruments in the departmental office. One fireman looks after the temperature control for twenty-one of these furnaces, and he is solely responsible for the heat. Fuel and air valves are located at the back of the furnaces where they can be easily reached from a handy walkway. Oil consumption per furnace is between 2 and 3 gal. per hour. Hardening temperature is 1,420 to 1,430 deg. F. for the small sizes of cups and cones, and up to 1,470 for parts of larger section.

The latest development in regard to temperature control is the installation of automatic temperature regulators which are able to keep the temperature within ±5 deg. F. These controllers, which have been developed at the Timken plant, are extremely simple and much cheaper than any of the various devices now on the market. The principle is to divide the original oil line to the burner into two feed lines, each with a needle valve. One of these valves is adjusted so that if the oil was flowing permanently through this line the furnace temperature would be considerably above that desired, and the other valve adjusted so as to give a temperature somewhat below that desired. Oil is caused to flow alternately through one or the other of these valves by means of a small tapered valve with two orifices, from which pipes lead to the two needle valves. This valve is mounted on a shaft and can be brought to revolve about 90 deg. by means of arms with attached pins acting through two solenoids. Holes in the tapered valve are so arranged that when one is open the other one is closed, and vice versa.

This apparatus works in conjunction with a Leeds & Northrup recording and controlling potentiometer and when the temperature becomes, say, 5 deg. higher than desired, a relay is closed, sending a current through one of the solenoids and causing an electromagnetic force to pull the pin in the core of the solenoid downward and through the arm attached to the shaft. The tapered oil valve is simultaneously caused to turn about 90 deg., thus shutting off the oil to the needle valve regulated for the higher temperature and opening the hole leading to the needle valve regulated to give the lower temperature. The action of the instrument when the temperature becomes too low is just the reverse. Thus the oil is caused to flow alternately through one or the other of the needle valves. The controller is so set that this change is effected as soon as the temperature on the thermocouple differs more than 5 deg. F. from that desired.

If only one furnace is controlled from each recording instrument the usual standard Leeds & Northrup in-

strument with signal lights can be used unaltered (or with a slight change in the circuit breakers to prevent arcing), with the wires to the red and blue lights reconnected to the two solenoids respectively. In order to reduce the cost of the instruments, however, it has been found desirable to connect more than one furnace to each recorder, and it is possible to run up to five furnaces from each controlling instrument. This necessitates rather elaborate switches and a very close setting of the oil valves. It has therefore been finally decided to control two furnaces from each instrument, which has proved very satisfactory, and it is now planned to extend the use of these automatic controllers all through the heat-treating department.

Quenching cups and cones is done in specially designed hardening machines, one placed in front of each furnace. Figs. 9 and 10 show these in outline and perspective. The main advantages of these machines are that they closely control the size of the hardened work. Quenching is also effected by means of a strong water spray instead of by mere immersion. A far more effective quench is therefore given than by the old methods and will give a more uniformly hard product. This is especially important for roller bearings, where soft spots would invariably mean failure in service.

The machine is equipped with two plungers that are moved up and down by the action of levers connected to an air cylinder as clearly shown in the drawing. Special fixtures are used for the hardening cups and cones in these machines. When a cup approaches the discharge door of the furnace, the operator lifts it out with a small hook, places it against the locating pins in the bowl, and turns the operating lever. This brings down the plunger, with the fixture attached to its lower end, into the cup at great speed. The spiral fluted fixture is larger than the hot cup and expands it a tiny bit. The bowl is depressed into the water basin, and at the same time water rushes up through the hole in the center of the bowl and out through the flutes in the fixture. Water from several jets also strikes the cups from the outside simultaneously and in this way the heated metal is rapidly chilled from both the inside and outside in such a way that there is a minimum chance for formation of gas bubbles or dead volumes in the quenching bath, and the ring is also rigidly held to shape during cooling. It has recently been found safer and more desirable to operate the water valves by a lever motion controlled from the upper toggles than by the valve pin arrangement shown in Fig. 9.

As the one side is operating in this manner, exactly the opposite sequence of events automatically takes place on the other side. The water jets close, the bowl and grill rise above the water surface, water is drained out of the bowl, the interior fixture rises clear of the hardened cup, which is hooked out and replaced by another hot one.

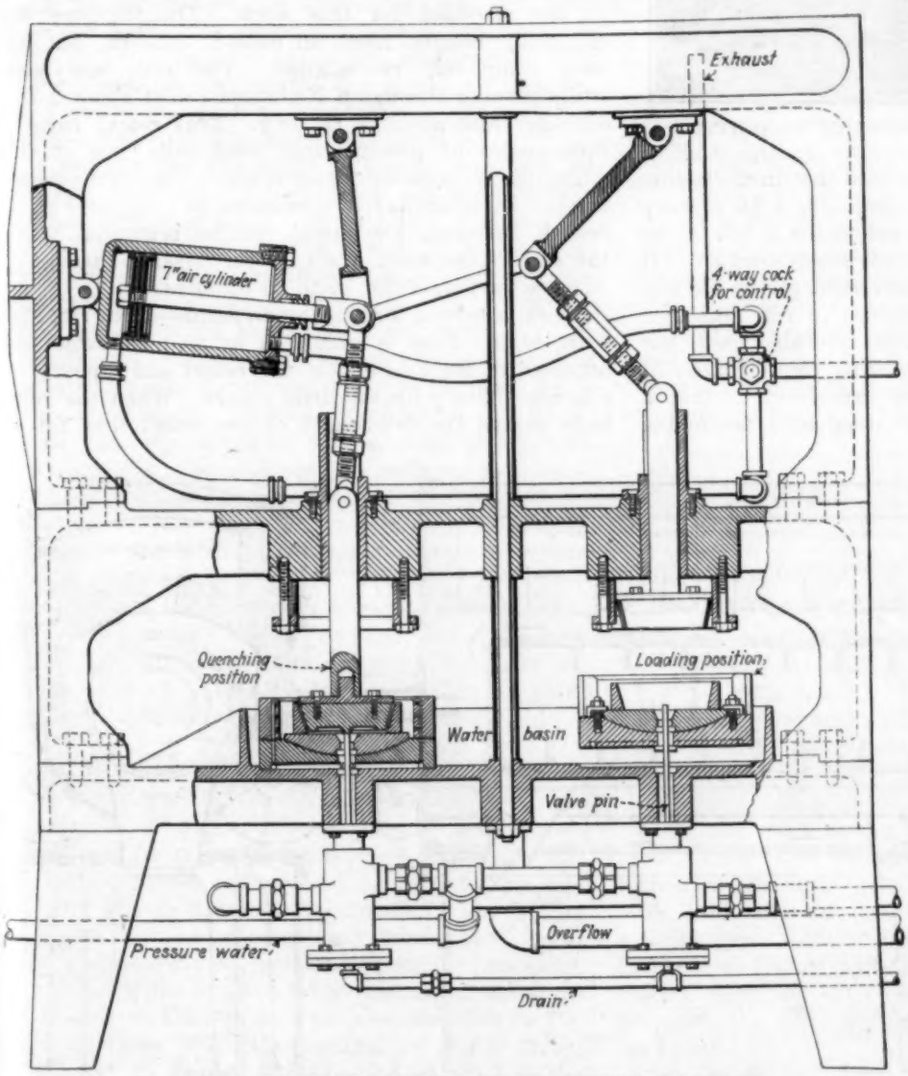

FIG. 9—REAR ELEVATION OF QUENCHING MACHINE

Cones are quenched in the same machine, but different fixtures are used. At times another type of machine is used, where the cones are simply submerged into water with a solid plunger inserted into the heated cones. Most cones, however, are hardened in the same machines as are the cups. The fixture used is a cylindrical plunger drilled centrally and split into six fingers. The lower end of the central hole is ground to a taper which, on the downward stroke, hits a pin of slightly larger size but of the same taper. This forces the fingers out, and the fixture is expanded tightly against the cylindrical bore of the cones.

These quenching machines are extremely speedy and one skillful operator, if he does not have to feed the furnaces, can harden 500 pieces per hour. In order to see that everything is working properly, inspectors check the product for size from the various machines three to four times an hour. In addition to this, all raceways are afterward subjected to a 100 per cent file inspection for hardness. Cones are tested by trying to touch them with new files around the circumference. For cups, which must be hard on the in-

FIG. 10—PERSPECTIVE OF QUENCHING MACHINE

side, a special method has been devised that in all its simplicity works very efficiently. By breaking a file a sharp edge is formed, which is poked against the inside of the cups in such a way that the cups roll slowly forward. If there are any soft spots the sharp point of the file will dig into the metal; the cups refuse to roll and then slide forward. A few scleroscopes are also used, but these are better adapted for checking the hardness of ground and finished work. Our experience is that a better hardness inspection is obtained by a file in the hand of a reasonably good man than by any other method. The main reason for this is that defects in casehardened work are mostly in the form of soft spots. Testing with a scleroscope would require a large number of readings on each part to find one soft spot, while a file test will cover a large area of the surface at one time.

Hardening Rollers

There now remains to be told how the rollers are heat-treated. As noted before, the rollers are the parts in the bearings subjected to the most severe service and every effort is made to give them a correspondingly high strength. They contain 1 per cent chromium, and the hardening temperature is thus raised to about 1,500 deg. F. As a matter of fact, each roller is given a double quench, the first in oil from a temperature slightly above 1,500 deg. F. and the second in water from a temperature slightly below 1,500 deg. F. The intention of this double quench is to refine the case as much as possible and at the same time to obtain a fine-grained center. Experience has shown that better results are obtained by this method than by the usually employed method of a double quench from 1,550 and 1,450 deg. F. respectively. Our practice not only refines the outside layers of the case, but the refinement is driven the full depth of case in the carburized rolls.

Seventeen furnaces with rotary retorts shown in Fig. 11 are provided for this work. The furnaces were originally bought from an outside concern, but have been completely re-designed. The rolls are heated while passing through a Nichrome retort about 2 ft. in diameter and about 7 ft. long. This retort turns on three pairs of power-driven steel rolls, one of them engaging a double-flanged track to prevent endwise creep. By a similar arrangement to that used on the hearth furnaces, the speed can be regulated to suit the size of the work, the time for passing through the furnace varying from 10 to 25 minutes.

Work is moved forward by an inside spiral rib, about 3 in. high. Feed is regulated by an adjustable scoop attached to the cold end of the retort and dipping into a hopper filled with the little rollers. When the rollers have passed the full length of the retort they fall out

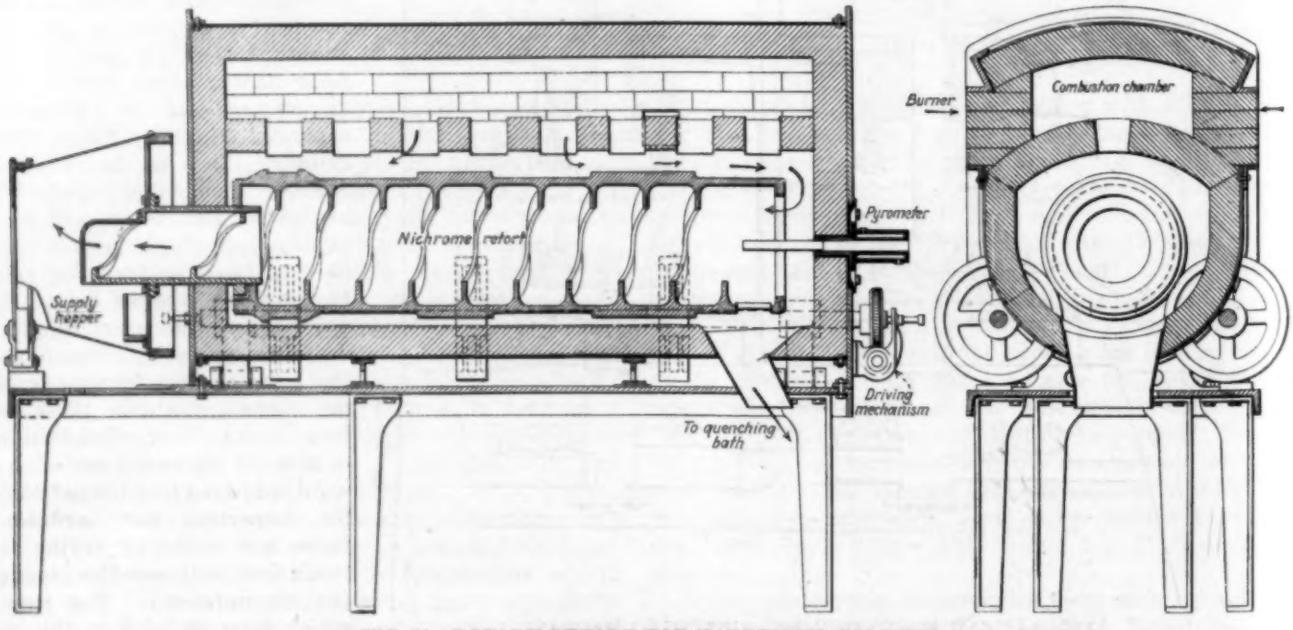

FIG. 11—ROTARY RETORT FOR HARDENING ROLLERS

through a slot in the wall and by means of a guiding chute into the quenching liquid.

The retort is contained in a brick chamber with double arches. The combustion chamber consists of the space between these arches; two oil burners project into this chamber in opposite directions, one near the front and the other near the back of the furnace. Hot gases are conducted through slots in the lower arch into the main furnace chamber, where they play around the retort and escape at the various joints. The burners are so adjusted that the heat gradient rises as the work progresses through the furnace, until proper hardening temperature is reached a little ahead of the discharge end.

As the rolls are discharged from the furnace, they are guided by a small chute, leading to the quenching bath immediately in front and below the furnace. Oil is used for the first quench and water for the second. The oil used is Houghton's No. 2 quenching oil, pumped from a large supply tank holding about 80,000 gal. As this tank is located at a considerable distance from the hardening room, radiation from the long pipe lines makes a special cooling plant superfluous. The oil for the first quench, as well as the water for the second, enters the cooling bath through several jets, set in various directions and so arranged that an effective and reliable quench of the rolls is obtained.

After having passed the quenching bath the rolls land on the inside of a partly submerged cylinder made of wire screen. Interior vanes are so arranged that as the cylinder slowly rotates the quenched rolls are elevated out of the bath and discharged over the edge of the tank into draining boxes set alongside.

Rolls are checked for hardness by file test and for fracture by splitting sample rolls at regular intervals in a small hydraulic press. In this way a very close control of the hardening of the rolls is maintained. After several cleaning operations done in rotary drums holding various substances, the rolls are ready for grinding and leave the hardening department.

In conclusion it can be said that no effort or cost has been spared in the development of the Timken heat-treating departments. Practically all of the equipment has been specially designed and a large number of patents have been granted on the various machinery that is used. The Timken company thus owns patents covering the rotary hearth furnaces, the quenching machines, the special fixtures used for hardening cups and cones, the temperature controllers, the roll-hardening furnaces and the quenching apparatus for the rolls, to mention only some of the more important. The high quality of the Timken bearings depends on these departments as much as on any other branch in the plant and they are equipped and conducted accordingly.

Composition of Beet Sugar Press Cake

The dry material of the filter press cake produced in the process of manufacturing beet sugar consists largely of calcium carbonate, according to the findings of the United States Department of Agriculture, and undoubtedly affords a satisfactory material for liming soils. It also contains comparatively small quantities of nitrogen, phosphoric acid, potash and organic material.

The results of the analysis of a number of representative samples of filter press cake are set forth in Department Circular 257, "Composition of Filter Press (Lime) Cake," by Sidney F. Sherwood, chemist in the Bureau of Plant Industry.

Coatings That Prevent End Checks in Wood

Wood dries more rapidly from the end grain than from the side grain, and is apt to check and split during seasoning unless end drying is retarded by some means. For this reason it is advisable to use a water-resistant end coating on wood during air seasoning or kiln drying, especially on woods which are difficult to dry and on short kiln samples.

Two Classes of Coatings

The coatings ordinarily used can be divided into two classes. The first are liquid at ordinary temperatures and can be applied cold. The second are solid at ordinary temperatures and must be applied hot. Cold coatings have the advantage that they may be used as easily on logs and lumber as on kiln samples and dimension stock; hot coatings, because of the method of application (end dipping), are not easy to use on large stock.

Either the cold or the hot coatings can be used effectively for drying temperatures up to 140 deg. F. Temperatures much above this cause blistering in the cold coatings, but make the hot coatings plastic enough to form new surfaces as fast as the old ones break. For this reason the hot coatings are apt to be more effective than the cold coatings for temperatures from 140 up to 170 deg. F., where they liquefy to such an extent that they run off. No coating has been found which is entirely satisfactory for temperatures above 170 deg. F. Cold coatings are perhaps somewhat better than hot coatings for temperatures above 170 deg. F. and for use on kiln samples when the temperatures are high enough to cause the loss of part of a hot coating.

Effectiveness of Cold Coatings

Cold coatings to be effective should have about the consistency of heavy sirup. The amount of filler required ranges from two to four parts by weight to one of the vehicle. Cold coatings used at the Forest Products Laboratory, Madison, Wis., have been found effective about in the following order, the most effective being placed first:

Hardened gloss oil and air-slaked lime—(oil evaporated to consistency of thin sirup before adding the lime)	Very cheap
Chinawood oil and barytes	Cheap
Linseed oil and white lead (very heavy)	Moderate cost
Linseed oil and red lead (very heavy)	Moderate cost
High grade spar varnish and barytes	Expensive

Effectiveness of Hot Dips

The hot dips were effective in the following order:

213 deg. coal-tar pitch	Cheap
254 deg. coal-tar pitch	Cheap
Rosin and lampblack—(100 parts of rosin to 7 parts of lampblack)	Moderate cost

Some asphalts are highly moisture-resistant, but they are difficult to apply because of the high temperatures required to make them plastic.

Paraffine has proved very satisfactory as an end coating for stock during air seasoning, but cannot be used in the kiln because of its low melting point. Excessive shrinkage of the wood and rough handling often cause the end coatings to chip or shear off, and a fresh application of the coating must be made. To reduce end-drying sufficiently there must be a thick coating over the entire end surface. When hot dips are used, the wood should be dipped half an inch into the liquid.

This work has been carried out by the Forest Products Laboratory at Madison, Wis.

Licensing Laws for Engineers

A Survey of Licensing Conditions as Affecting Professional Engineers in Various States

THE situation regarding license laws for engineers is one that deserves the serious attention of chemical engineers everywhere. Already the movement has resulted in the passage in twenty-five states of laws which affect engineers in some way. In most of these states anyone engaged in work that is defined as "professional engineering" is required to obtain a license. The New York State definition of "professional engineering" is the usual definition employed, and we quote:

Sect. 39-*n*. *Professional Engineering.* A person practices professional engineering within the meaning and intent of this article, except as hereinafter stated, who holds himself out as able to do, or who does, the work that an engineer does in the planning, designing, constructing, inspecting and supervising of engineering work, or appliances involved in public or private projects, or in making investigations for proposed engineering projects.

The New York law contains the following exemptions, usual but not contained in all state laws:

Nothing herein shall apply to a corporation, partnership or joint-stock association, provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint-stock associations shall be licensed engineers, and nothing in this article shall be construed to apply to the preparation or execution of designs, drawings, plans or specifications for the construction or installation of machinery or apparatus constructed or installed by the corporation, partnership or joint-stock association preparing such designs, drawings, plans or specifications if the supervision of the preparation of any such designs, drawings, plans or specifications, construction or installation shall be under the general direction of a licensed engineer.

Qualifications for License

The qualifications for license are of particular interest to prospective applicants. Again the New York State law gives the average qualifications, and we quote an excerpt from this law which contains information on requirements and issuance of certificates and seals which will serve to illustrate to the reader what the majority of such laws cover:

Extract From Laws of New York State

Chapter 775 *as amended by Laws of* 1921
Taking effect May 5, 1923

Sect. 39-*e*. *Applications for and Issuance of Certificates.* The Regents, on application therefor, on prescribed forms and the payment of a fee of $25, except in cases where the applicant applies for license to practice professional engineering and land surveying, when the fee shall be $35; and except as hereinafter provided, shall on the recommendation of the board issue a certificate of license:

1. To any person who submits evidence satisfactory to the board that he or she is fully qualified to practice professional engineering or land surveying.

Provided, however, that no person shall be eligible for license as a professional engineer who is under 21 years of age, who is not of good character and repute and who has not been actively engaged for 4 or more years in the practice of professional engineering of a character satisfactory to the board.

Provided, however, that no person shall be eligible for license as a land surveyor who is under 21 years of age, who is not a citizen of the United States or who has not made declaration of his or her intention to become a citizen of the United States, who does not speak and write the English language, who is not of good character and repute and who has not been actively engaged for 3 or more years in the practice of land surveying of a character satisfactory to the board.

However, each 2 years of study, satisfactorily completed, of engineering in a school of engineering of standing satisfactory to the Regents shall be considered as equivalent to 1 year of such active practice.

Unless disqualifying evidence be before the board, the following facts established in the application shall be regarded as prima facie "evidence, satisfactory to the board," that the applicant is fully qualified to practice professional engineering or land surveying.

(*a*) Six or more years of active engagement in professional engineering work, one of which shall have been in responsible charge of work, or in the case of applicants for license as a land surveyor, 4 or more years of active engagement in land surveying work of a character satisfactory to the board.

(*b*) Graduation, after a course of not less than 4 years in engineering, from a school or college approved by the Regents as of satisfactory standing, and an additional 4 years of active engagement in professional engineering, 1 of which shall have been in responsible charge of work, or 2 years of active engagement in professional land surveying of a character satisfactory to the board.

Applicants for license, in cases where the evidence originally presented in the application does not appear to the board conclusive or warranting the issuance of a certificate, may present further evidence, which may include the results of a required examination, for the consideration of the board.

In determining the qualifications of applicants for license as professional engineers or land surveyors a majority vote of the members of the board shall be required to pass the candidate.

In case the board denies the issuance of a certificate to an applicant, the license fee deposited shall be returned by the Regents to the applicant.

2. To any person who holds an unexpired certificate of license issued to him or her by a legally constituted board of examiners in the District of Columbia or in any state or territory of the United States in which the requirements for the license or registration of professional engineers or land surveyors are of a standard not lower than those prescribed in this state, provided that an agreement of reciprocity in the matter of indorsement of such certificates of license shall have been entered into between the Regents of the University of the State of New York, the board of examiners of this state and the like duly constituted authorities in the District of Columbia or in any other state or territory of the United States.

Sect. 39-*f*. *Certificates.* The result of every examination or other evidence of qualifications, as provided by this article, shall be reported to the Board of Regents by the board of license, and a record of the same shall be kept by the Board of Regents, and the Board of Regents shall,

SURVEY OF STATES HAVING LICENSE LAWS

Name of State	Affects Ch. Eng'r.	Where to Apply for Complete Information
Alabama	Yes	Judge of Probate in each county
Arizona	Yes	State Board of Registration of Architects and Professional Engineers, Phoenix
California	No	Surveyor-General, State Capitol, Sacramento
Colorado	Yes	State Board of Examiners for Engineers and Land Surveyors, Denver
Florida	Yes	State Board of Engineering Examiners, G. K. Armes, Sec., Tallahassee
Idaho	Yes	Department of Law Enforcement, Paul Davis, Boise
Illinois	No	Department of Registration and Education, Springfield
Indiana	Yes	State Board of Registration for Professional Engineers, DeW. D. Moore, Indianapolis
Iowa	Yes	State Board of Engineering Examiners, K. C. Kastberg, Sec., Des Moines
Louisiana	No	State Board of Engineering Examiners, Baton Rouge
Michigan	Yes	State Board of Examiners of Engineers, George Jerome, Sec., Detroit
Minnesota	Yes	State Board of Registration of Architects, Engineers and Land Surveyors, St. Paul
Nevada	Yes	State Board of Registered Professional Engineers, Carson City
New Jersey	Yes	State Board of Professional Engineers and Land Surveyors, Trenton
New Mexico	No	Board of Examining Surveyors, Santa Fe
New York	Yes	State Board of Licensing for Professional Engineers, Albany
North Carolina	Yes	State Board of Registration for Engineers and Land Surveyors, Raleigh
Oregon	Yes	State Board of Engineering Examiners, A. B. Carter, Sec., Portland
Pennsylvania	Yes	State Board of Registration of Professional Engineers and Land Surveyors, Harrisburg
South Dakota	No	State Engineer, Pierre
Tennessee	Yes	State Board of Examiners for Architects and Engineers Nashville
Texas	No	Board of Examiners of Land Surveyors, Austin
Virginia	Yes	Board for Examination and Certification of Professional Engineers, Richmond
W. Virginia	Yes	State Board of Registration of Engineers, George E. Taylor, Sec., West Union
Wyoming	Yes	Board of Examining Engineers, Fremont Morrison, Sec., Cheyenne.

unless deemed otherwise advisable, issue a certificate of license to every person certified by the board of license as having passed such examination or as being otherwise qualified to be entitled to receive the same.

Sec. 39-*i*. *Significance of Certificate—Seals.* The issuance of a certificate of license by the Regents shall be evidence that the person named therein is entitled to all the rights and privileges of a licensed professional engineer or land surveyor, while the said certificate remains unrevoked or unexpired.

Each licensee hereunder may upon being licensed obtain a seal of the design authorized by the board, bearing the licensee's name and the legend "licensed professional engineer or licensed land surveyor." Plans, specifications, plats and reports issued by a licensee may be stamped with said seal during the life of licensee's certificate, but it shall be unlawful for anyone to stamp or seal any documents with said seal after the certificate of the licensee named thereon has expired or has been revoked unless said certificate has been renewed or reissued.

EXTRACT FROM RULES OF THE BOARD OF LICENSING

Responsible charge of work, as referred to in the act, shall be understood to mean the control and direction of the investigation, design and construction of work requiring initiative, skill and independent judgment in meeting unforeseen conditions. The board, in passing on this requirement, will carefully weigh the evidence of experience submitted by the applicant.

The term "principal" as used in the act will be understood to mean an engineer in charge of work who is directly responsible to his client, employer or superior officer for results in connection therewith, even though he may have under his supervision and direction on such work assistants who have responsible charge of certain features thereof.

CONDITIONS IN VARIOUS STATES

While the conditions for licensing vary somewhat among states, most states have requirements equal to or less than those of New York. Those states having more severe requirements are Colorado, Illinois, Indiana, Pennsylvania, Tennessee and West Virginia.

In some states the provisions apply only to special classes of engineers and do not apply to chemical engineers. We give herewith, in table form, the states requiring license; those in which chemical engineers are affected; and the address to which to write for complete information.

Moisture-Resistant Coatings for Wood

Shrinking and swelling and internal stresses causing warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating.

In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis. No coating or finish which is entirely moisture-proof has yet been discovered, but several have been found which are very effective.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection.

Oil paints form a film over wood which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

RELATIVE EFFICIENCY OF WATER-RESISTANT COATINGS FOR WOOD

	Percentage Efficiency
Aluminum-leaf process—asphalt paint base	98
Three coats spar varnish coated with vaseline	98
Three coats of asphalt paint	96
Aluminum-leaf process—spar varnish base	95
Aluminum-leaf process—cellulose lacquer base	94
Aluminum-leaf process—oil paint base	93
Three coats of aluminum bronze (quick drying)	92
A heavy coating of paraffine	91
Three coats of rubbing varnish	89
Three coats of enamel	88
Three coats of orange shellac	87
Three coats of cellulose lacquer	73
Sheet pyralin 0.005 in. thick glued to wood	68
Three coats of graphite paint	61
Three coats of spar varnish	60
Three coats of whitelead oil	54
Five coats of linseed oil applied hot and two coats of wax	38
No coating	00

Cellulose lacquers rank somewhat higher than the foregoing in moisture resistance. Considerable improvements can probably be effected in them by the addition of solids. They have the advantages that they are fast drying and that the films they form over the wood are very elastic.

Rubbing varnishes afford considerably more protection against moisture than do spar or long oil varnishes. The larger amounts of gum solids present in rubbing varnish probably account for their greater moisture resistance.

Enamel coatings made by the addition of pigments, such as barytes, to ordinary varnish are about as effective as rubbing varnish.

A bronze coating composed of a cheap gloss oil and aluminum powder proved in tests to be superior in moisture resistance to any of the coatings mentioned above. This mixture is very fast drying; three coats can be applied in the course of half an hour.

The aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers is highly efficient in preventing moisture changes in wood. Such a coating can best be applied to large unbroken surfaces.

For temporary protection against moisture changes, vaseline smeared over varnish is one of the most moisture-resistant coatings yet tested.

The accompanying table gives the results of moisture absorption tests on panels coated with the different preparations. The percentages are based on average amounts of moisture absorbed per unit surface area by coated and uncoated panels subjected to a humidity of 95-100 per cent for 14 days.

Increase in British Exports of Tin

During the months of December and January the quantity of tin plates exported to the United States from Great Britain totaled more than the amount sent in the whole of the preceding 36 months. From other parts of the world as well there has also been a noticeable revival in the demand for tin. As a result Britain's exports are now between 42,000 and 43,000 tons per month. As will be seen from the following statistics, Britain's tinplate industry centering in South Wales has practically regained its pre-war position as an exporter.

Year	Gross Tons	Value, f.o.b.
1913	494,497	£7,214,938
1920	353,058	18,954,053
1921	226,440	9,077,292
1922	448,907	9,695,936

How Do You Operate A Column Still?

By F. H. Rhodes
Professor of Industrial Chemistry, Cornell University

THE column stills commonly used for the separation and rectification of liquids by fractional distillation consist of the following essential parts:

1. The still body, or "kettle."
2. The fractionating column, in which the original vapor from the still is caused to pass upward countercurrent to and in intimate contact with a downflowing stream of "reflux" introduced at the top of the column.
3. The partial condenser, or "dephlegmator," in which a portion of the vapor from the top of the column is condensed and returned to the top of the column as "reflux," while the remainder of the vapor is allowed to pass forward to the final condenser.
4. The final condenser, in which the vapor is condensed completely to "distillate" and the distillate is cooled so that it may be sent to the receivers.

The general arrangement of such a still designed for operation by the "partial condenser method" is shown diagrammatically by the accompanying Fig. 1.

Of course the partial condenser method is the one that is generally practiced. This has certain distinct disadvantages as compared with the single condenser method of operating a column still, among which are the greater ease of control and the greater constancy of the reflux-distillate ratio under varying conditions of operation. This article tells why the single condenser method is better.

The primary purpose of the partial condenser is to provide the reflux to the column so that the column may continue to act as a fractionating device. The same result may be secured by omitting the partial condenser entirely and providing the necessary reflux by condensing all of the vapor in a single condenser and properly dividing this total condensate into reflux and distillate by means of valves or other suitable device. The general arrangement of such a still arranged for operation by the "single condenser method" is shown diagrammatically by the accompanying Fig. 2.

This method is not new; it has been described repeatedly in the literature and has been used commercially to a limited extent. In most industrial distillation operations, however, the feasibility of the single condenser method has not been realized and its advantages have not been appreciated, so that at present most fractional distillation operations are carried out in stills provided with a partial condenser and operated by the partial condenser method.

This present article was written for the purpose of calling attention to some of the advantages, from a practical operating standpoint, of the single condenser method of still operation. With any given column, operating on an initial vapor of any given composition, there is an optimum ratio between the portion of the total condensate returned to the column as reflux and the portion taken off as distillate. With less than this optimum reflux ratio the fractionation will be insufficient to give a distillate of the attainable and desired purity; with a reflux ratio greater than the optimum ratio a very slight increase in the purity of the distillate will be secured at the expense of a very considerable increase in the time and the amount of heat required to produce a given quantity of distillate. It is obvious, therefore, that the maximum efficiency and economy of operation can be secured only by maintaining, at each stage of the distillation, a certain definite ratio between the reflux and the distillate; and that variation from this optimum ratio will result either in unduly impure distillate or in unnecessary cost of operation.

It is difficult, with a partial condenser, to maintain a constant ratio between reflux and distillate. The usual type of partial condenser consists of a set of vertical tubes through which the vapor is passed and around which the water or other cooling medium is circulated, although in some cases partial condensers are used which consist of a set of horizontal tubes through which the water is circulated and around which the vapor is passed. In either case, a change in the temperature or in the rate of flow of the cooling liquid produces a change in the amount of vapor condensed in the partial condenser and thus causes a variation in the reflux ratio. Moreover, when the partial condenser is carefully regulated to give a uniform *amount* of reflux, the *ratio* of reflux to distillate may be changed by a variation of the rate of distillation of the charge within the still body. It is obvious, therefore, that in a still provided with a partial condenser maximum efficiency and economy can be secured only by maintaining very close control over the operation of the partial condenser.

In a still arranged for operation by the single condenser method it is possible to install, below the condenser, a dividing device which will automatically separate the condensate into reflux and distillate and which can be set to maintain any desired ratio between reflux and distillate. In this way the ratio of reflux to distillate can be kept constantly at the optimum value and the still can be operated constantly at maximum efficiency, irrespective of any probable fluctuation in the temperature or the rate of flow of the cooling water or in the rate of distillation. Therefore the still can be operated more efficiently and more economically and with less supervision than can a still operated by the partial condenser method.

Another advantage of the single condenser method of operation is the ease with which the reflux ratio can be adjusted to meet changes in the composition of the vapor entering the fractionating column. In any dis-

continuous distillation process the vapor entering the bottom of the column becomes progressively poorer in the lighter component as the distillation proceeds, and in running any particular fraction it is necessary to increase the reflux ratio progressively to meet this change in vapor composition; in any discontinuous distillation process there may occur variations in the composition of the feed which necessitate a change in the reflux ratio. In a still operated by the partial condenser method this change in reflux ratio is effected by changing the rate of flow of the cooling water. The exact effect of any given change in the rate of flow of cooling water can be predicted only by experience and determined only by trial. Moreover, the full effect of a given change in the rate of flow of cooling water does not appear at once, but develops rather slowly. These facts render it necessary to control a partial condenser still largely by the method of "trial and error" and necessitate close attention and frequent regulation in order to obtain satisfactory results.

Moreover, the difficulties of control make it difficult to standardize the operation of the still and make it necessary to rely very largely upon the judgment of the still runner. In a still operated by the single condenser method, the dividing device can be calibrated and provided with a scale to indicate the ratio between reflux and distillate corresponding to any position of the divider. The exact effect of a given change in the position of the divider can be foretold very closely and the change in reflux ratio necessary to meet any change in the conditions within the still can be made easily and quickly. Moreover, the full effect of a change in the reflux ratio appears very soon after the change is made. For these reasons, a still operated by the single condenser method requires a minimum of attention, and the operation of such a still can be standardized so that it is not necessary to rely so much upon the judgment and experience of the still runner.

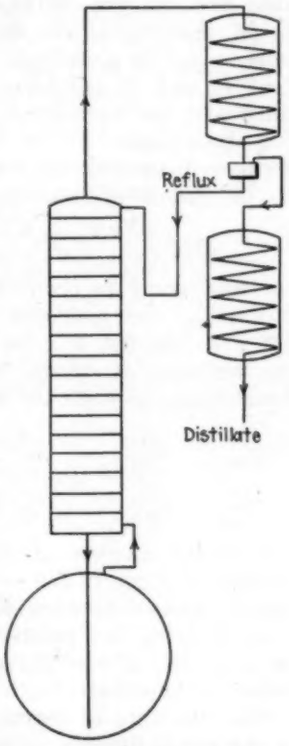

FIG. 1—PARTIAL CONDENSER METHOD

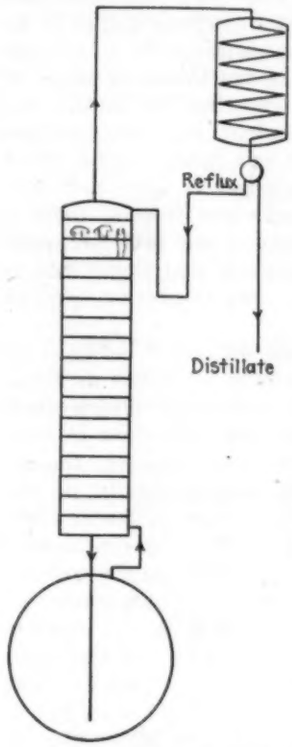

FIG. 2—SINGLE CONDENSER METHOD

A third advantage of the single condenser method is the fact that it can be applied successfully to the fractional distillation of high-boiling liquids, while with the partial condenser method the regulation of the reflux ratio (and therefore the proper control of the fractionation) becomes very difficult when working with substances which boil at temperatures considerably above the boiling point of water. In a partial condenser handling vapors which condense below, or only slightly above, 100 deg. C. the reflux may be regulated by varying the rate of flow of cooling water through the condenser. With vapors condensing at somewhat higher temperatures, the dephlegmator may be partly filled with water which is kept boiling by the heat absorbed from the vapor, and the amount of material condensed as reflux may be varied by varying the *height* of the boiling water surrounding the condenser tubes.

This method is not very satisfactory, because the exact regulation of the height of the boiling water in the condenser is rather difficult and because a slight change in the height of the water may produce a very large change in the amount of material condensed as reflux. With vapors which condense at temperatures considerably above the boiling point of water it is usually necessary to resort to the use of air-cooled partial condensers, which are very difficult to regulate, or to use partial condensers cooled by circulating oil, which present obvious operating difficulties. With the single condenser method of operation, high-boiling liquids can usually be handled in essentially the same manner as liquids which condense at relatively low temperatures—i.e., with a water-cooled condenser and a dividing box—and the reflux ratio can be controlled as accurately and as easily as when working with liquids which condense at temperatures below the boiling point of water.

For example, naphthalene may be distilled fractionally by the single condenser method about as easily as can benzene, whereas the fractional distillation of naphthalene in a still operated by the partial condenser method presents considerable difficulty. Of course, if the distillate has a melting point above the boiling point of water, it will be necessary to use an air-cooled condenser instead of a condenser cooled by water, but even this introduces no particular difficulty, since it is not necessary to *regulate* the amount of condensation in the air-cooled condenser, but only to insure that the amount of cooling surface is sufficient to condense all of the vapor. Thus it is evident that the single condenser method of distillation has a much wider range of application than has the partial condenser method.

Some Objections to the System

One objection to the single condenser method of operation that is sometimes raised is that it is not possible, by this method, to recover and utilize the heat contained in the vapor. In continuous stills operated by the partial condenser method the crude liquor going to the still is frequently used as the cooling medium in the partial condenser, so that the heat liberated by the condensation of the reflux is utilized to preheat the still charge. In a single condenser still exactly the same result may be secured by building the condenser in two sections in series, the upper section being cooled by the ingoing charge to the still and only the lower section being cooled by water, and the total condensate from the entire condenser being separated into reflux and distillate by means of the dividing device. In some

cases it is even possible to condense *all* of the vapor in a single condenser cooled by the ingoing charge and to pass only the condensed distillate through a water-cooled "cooler" placed below the dividing device; and in such cases the amount of heat recovered is actually greater than the amount usually recovered in stills operated by the partial condenser method. The use of such a two-stage condenser or of a condenser and cooler does not in any way interfere with or complicate the control of the reflux ratio. Therefore it is evident that the thermal efficiency of a still operated by the single condenser method is just as high as the thermal efficiency of a still operated by the partial condenser method and giving the same quality of distillate from the same still charge.

Another objection to the single condenser method of operation is that the reflux has exactly the same composition as the distillate, whereas the reflux obtained from a partial condenser is richer in the heavier components and poorer in the lighter component than is the distillate. In other words, by adopting the single condenser method we sacrifice the fractionating effect of the partial condenser. It is true that the partial condenser does act, to a certain extent, as a fractionating device; but it is also true that as a fractionating device the usual form of partial condenser is very inefficient. The contact between liquid and vapor is poor, there is considerable difference in temperature between vapor and condensate, and the condensate and vapor usually flow in parallel rather than in counter current through the condenser.

In running pure fractions the difference between the reflux and the distillate is usually so slight as to be undetectible; in running wide-boiling or intermediate fractions there may be considerable difference in composition. In practically every case, however, the increased fractionation and the greater purity of the product obtained by the use of a partial condenser could be secured in a still operating on the single condenser method by simply adding one more plate to the column. Furthermore, it is possible to use, in a single condenser installation, a condenser which is made up of two units in series, and so to arrange the dividing box that substantially all of the reflux is obtained from the first unit and substantially all of the distillate is obtained from the second unit. In this way the advantages of the single condenser method of operation can be secured without sacrificing the slight fractionation obtained by the use of a fractional condenser.

Summary

In summation, therefore, the single condenser method of operation offers the following advantages:

1. The ratio between the reflux and the distillate may be maintained constant at any desired value, irrespective of any fluctuation in the rate of flow or the temperature of the cooling water or of any variation in the rate of distillation.

2. The reflux ratio may be more easily regulated, thus permitting better control of the fractionation and making it possible better to standardize the operation of the still.

3. Fractional distillation may be applied to the separation and purification of high-boiling materials as well as to the rectification of liquids which boil at relatively low temperatures, and the close control of these high-temperature fractional distillations presents no particular difficulty.

The thermal efficiency of a fractional distillation process controlled by the single condenser method need be no lower than the thermal efficiency of a similar distillation process controlled by the partial condenser method—it may, in some cases, be higher.

The substitution of the single condenser method of operation for the partial condenser method may involve the sacrifice of the slight fractionating effect of the partial condenser, but this can be compensated for by a slight increase in the number of plates in the fractionating column or by the use of a double-effect condenser and a suitable arrangement of the dividing box.

Reduction of Hematite by Methane

While studying the reduction of iron ore by fuel gas, E. D. Eastman noted that at 700 deg. C. about one-fourth the hydrogen and CO and over half the unsaturated hydrocarbons were oxidized by reacting with iron ore, but the methane was practically untouched. C. M. Bouton, of the Bureau of Mines, verified this observation by passing a stream of mixed gas (40 per cent H_2 and 50 per cent CH_4) through a heated tube filled with fine hematite (+ 28, — 14 mesh) and analyzing the products of the reaction. If this gas take 30 seconds in passing the mass, Fe_2O_3 is reduced to Fe_3O_4 by the following reactions

$$3Fe_2O_3 + H_2 = 2Fe_3O_4 + H_2O$$
$$12Fe_2O_3 + CH_4 = 8Fe_3O_4 + 2H_2O + CO_2$$

the first going to completion (i.e., exhausting the gas mixture of free hydrogen) at any temperature between 600 and 900 deg. C. No CO is formed from the CO_2 or methane at these temperatures. Reduction of methane varies with the temperature, as follows:

Temperature, Deg. C.	Amount of CH_4 Consumed, Per Cent	*K*, Seconds
600	4	56,500
700	30	7,800
800	55	3,150
900	90	1,050

K is the number of seconds required for methane content of a gas to fall to one-tenth its value when the gas is agitated between walls of hematite 1 cm. apart.

In studying the reactions between gases and solids the scientists of the Bureau of Mines have erected the following hypotheses:

That the rate of reaction of each molecular species in the gas is directly proportional to the concentration of the molecular species.

That the passage of a gas through the intricate porosity of a fine ore is equivalent to passage between parallel walls of equal surface which inclose an identical volume.

That the rate of reaction of each molecular species (in terms of the percentage of the total gas) is inversely proportional to the distance between these equivalent walls.

Cascara Situation Causes Alarm

The Cascara tree, native of the Northwest, faces extinction. Unless steps are taken for its preservation and cultivation, this tree may not continue to flourish on this continent. It is cut at present as waste growth in many sections, despite the fact that its bark is of value commercially. When harvested the average tree of the Pacific coast yields 10 lb. of dry bark. Experiments conducted at the Agricultural Experiment Station on Vancouver Island indicate that the cultivation of this tree on cheap land may be fairly profitable.

Production Statistics of the Alkali Industry

The $81,884,100 Output in 1921 an 18 Per Cent Decrease From Record Total of 1919 —Soda Ash Leads

PRODUCTION statistics for one of the most formidable branches of the heavy chemical industry have just been released by the Census Bureau in the Department of Commerce. These figures show that the alkali industry of the United States had an output in 1921 aggregating in value $81,884,100, as compared with $99,689,828 in 1919, a decrease of 18 per cent.

Soda ash is the leading commodity of the group, with a production for sale of 776,520 tons, valued at $29,355,800, or 36 per cent of the group total in 1921, as compared with 1,033,480 tons, valued at $31,195,149, or 31 per cent of the total value in 1919.

Caustic soda is second, with 231,350 tons, valued at $18,434,300, or 23 per cent of the total value in 1921, and 302,121 tons, valued at $18,691,047, or 19 per cent of the total value in 1919.

TABLE I—PRODUCTION OF SODIUM COMPOUNDS IN THE UNITED STATES
(Ton, 2,000 lb.)

	1921	1919	1914
Aggregate value	$81,884,100	$99,689,828	.....
Inorganic			
Sodium:			*
Biborate (borax):			
Establishments	6	8	7
Production, tons	20,110	.....	.....
For sale, tons	18,500	29,635	26,501
Value	$2,745,200	$4,622,286	$2,071,774
Bichromate:			
Establishments	5	5	4
Production, tons	15,760	24,081	.....
For sale, tons	15,760	22,992	11,824
Value	$3,343,300	$5,337,389	$1,125,398
Bromide:			
Establishments	.....	5	.....
Pounds	*	1,242,443	*
Value	.....	$511,812	.....
Carbonates:			
Soda ash:			
Establishments	20	18	10
Production, tons	959,780	1,507,424	.....
For sale, tons	776,520	1,033,480	935,305
Value	$29,355,800	$31,195,149	$10,937,945
Sal soda (crystals):			
Establishments	29	41	50
Tons	68,760	82,992	106,591
Value	$2,161,800	$2,272,770	$1,510,449
Bicarbonate:			
Establishments	11	10	5
Production, tons	138,480	190,894	.....
For sale, tons	109,860	141,556	90,169
Value	$2,988,900	$3,695,417	$1,439,014
Sesquicarbonate:			
Establishments	.....	5	.....
Tons	*	37,854	*
Value	.....	685,500	.....
Fluoride:			
Establishments	.....	4	.....
Pounds	*	1,364,441	*
Value	.....	$177,420	.....
Hydroxide:			
Establishments	35	29	25
Production, tons	236,760	312,736	.....
For sale, tons	231,350	302,121	291,539
Value	$18,434,300	$18,691,047	$9,104,920
Repacked, tons	22,500	20,625	.....
Value	$3,294,700	$2,101,648	.....
Hypochlorite:			
Establishments	6	.....	.....
Production, tons	3,740	*	*
For sale, tons	3,625	.....	.....
Value	$324,000	.....	.....
Iodide:			
Establishments	7	7	.....
Pounds	26,140	29,284	*
Value	$88,300	$103,868	.....
Nitrate, refined:			
Establishments	.....	7	.....
Tons	*	10,153	*
Value	.....	$934,643	.....
Phosphate:			
Establishments	12	10	6
Production, tons	26,210	23,867	.....
For sale, tons	26,100	22,351	15,387
Value	$3,048,900	$2,438,917	$853,528
Silicate:			
Establishments	16	17	13
Tons	195,320	286,791	169,049
Value	$4,320,200	$6,052,318	$1,648,854
Sulphates:			
Niter cake:			
Establishments	13	38	31
Production, tons	22,770	97,836	46,143
For sale, tons	16,600	81,170	24,129
Value	$255,100	$281,476	$31,580
Salt cake:			
Establishments	18	34	29
Production, tons	127,600	179,003	110,263
For sale, tons	91,890	122,908	90,442
Value	$1,955,500	$1,930,139	$841,887
Glaubers salt:			
Establishments	18	27	20
Production, tons	60,160	42,206	.....
For sale, tons	52,040	38,330	34,537
Value	$1,289,000	$864,264	$427,808
Anhydrous (refined):			
Establishments	4	6	.....
Production, tons	2,040	2,776	*
For sale, tons	2,020	2,708	.....
Value	$154,000	$221,232	.....
Thiosulphate (hypo):			
Establishments	10	9	.....
Tons	17,830	29,678	*
Value	$1,202,900	$1,541,087	.....
Sulphide:			
Establishments	14	17	5
Production, tons	24,680	39,735	.....
For sale, tons	22,680	35,178	20,263
Value	$1,740,100	$2,316,253	$516,644
Sulphite:			
Establishments	7	8	5
Production, tons	3,740	8,666	.....
For sale, tons	3,440	7,209	.....
Value	$328,400	$539,636	$66,649
Bisulphite, etc.:			
Establishments†	13	.....	.....
Production, tons	12,830	*	*
For sale, tons	12,020	.....	.....
Value	$1,010,300	.....	.....
Washing compounds:			
Establishments	.....	3	7
Tons	*	861	12,441
Value	.....	$71,021	$204,230
Other inorganic ‡ value	$3,729,900	$7,021,278	$1,703,535
Organic			
Acetate:			
Establishments	6	12	.....
Production, pounds	312,320	2,260,459	*
For sale, pounds	312,320	2,196,113	.....
Value	$16,100	$165,505	.....
Benzoate:			
Establishments	.....	4	.....
Pounds	*	120,447	.....
Value	.....	$68,004	$61,490
Citrate:			
Establishments	7	6	.....
Pounds	112,660	118,417	*
Value	$74,000	$143,386	.....
Other organic, value	$23,400	$5,706,363	$80,630

* Figures not available.
† Includes also polysulphide, hydrosulphites, and sulphydrates.
‡ Includes metal, fluosilicate, refined chloride, nitrate, nitrite, bromate, bromide, fluoride, perborate, peroxide, chlorate and hypophosphite.

Next in rank are the silicate with 195,320 tons, value $4,320,200 in 1921, and 286,791 tons, value $6,052,318 in 1919; the bichromate, with 15,760 tons, value $3,343,300 in 1921, and 22,992 tons, value $5,337,389 in 1919; the phosphate, with 26,190 tons, value $3,048,900 in 1921, and 22,351 tons, value $2,438,917 in 1919; the bicarbonate with 109,860 tons, value $2,988,900 in 1921, and 141,556 tons, value $3,695,417 in 1919.

Then follow, in the order named as to value, the biborate (borax), salt soda (crystallized), salt cake, sulphide, glaubers salt and thiosulphate.

Detailed statistics for 1921, 1919, and 1914 are given in Table I. The figures for 1921 are preliminary and subject to such change and correction as may be necessary from a further examination of the original reports.

Tarnish on Silver

An investigation at the Bureau of Standards has shown that the tarnish ordinarily observed on silver is the sulphide film, of which certain colors are characteristic and indicative of the extent of the tarnish. The effect of hydrogen sulphide gas by itself on silver is relatively small, but if small amounts of moisture and sulphur dioxide are present, the action is greatly accelerated. Tarnishing is also made more rapid by the presence of alkaline films and soap films.

Friction Testing of Lubricating Oils

Extended Investigations at the Bureau of Standards Indicate That Journal Friction Testing Machine Is Not a Convenient Instrument for Measuring Oiliness, Because the Clearance Changes With Wear

BY WINSLOW H. HERSCHEL
Associate Physicist, Bureau of Standards

THE relation between viscosity and friction has been considered by numerous investigators,[1] but oiliness has never been defined in c.g.s. units and is much more difficult to investigate. Among the many suggestions of possible methods of test, there is the tentative conclusion of Wilson and Barnard[2] that differences in oiliness are indicated by a difference in the conditions under which a minimum coefficient of friction may be obtained on a journal oil friction testing machine.

A considerable amount of work has been done at the Bureau of Standards to investigate the possibility of measuring oiliness with a friction testing machine, and although the machine used had an incomplete bearing, it is believed that the conclusions reached will apply to all machines with journal bearings.

DESCRIPTION OF TESTING MACHINE

The oil friction testing machine used in the tests to be described was of the "Cornell" type. The journal has a diameter of 3.748 in. (9.5 cm.) and is 3.48 in. (8.84 cm.) long. The width of bronze bearing block is 2.01 in. (5.1 cm.). If the area of the oil grooves is deducted, the net projected area is 6.10 sq.in. (39.4 sq.cm.). The maximum load ordinarily used was 5,000 lb., or 715 lb. per sq.in. (50 kg. per sq.cm.). The speed could be varied from 43 to 814 ft. per minute (2.2 to 41.3 cm. per second). Temperatures were taken from readings of a thermometer inserted in the bearing block.

The arc of contact of the bronze bearing block was 65 deg., or less than half the arc of 163 deg. used by Tower[3] in most of his tests. This shortness of arc made it improbable that complete film lubrication could be obtained, although the bottom of the journal was allowed to dip into an oil bath.

Since the most interesting results are obtained near the point of seizure, it was necessary to provide that as little damage as possible should be done when seizure occurred, as indicated by the slipping of the belt. In order to guard if possible against roughening of the journal, a special bearing block of Ulco hard metal was used. This consisted mainly of lead and was 2x3½ in. (5.08x9.37 cm.), without oil hole or grooves, the excess length as compared with the journal being necessary because the latter is given a slow reciprocating motion by an eccentric, while the bearing block remains fixed. This arrangement serves to spread the lubricant.

It was found that the coefficient of friction was about 0.0007 less on decreasing than on increasing loads, but the cause was never determined. When tests were made with decreasing load, the calculated values of the coefficient of friction were therefore corrected by this amount.

Results of Friction Tests

In a previous paper[4] a new method was proposed for plotting results of tests on friction testing machines, and this method, which will be used in this paper, may be briefly described as follows. The coefficient of friction is calculated as usual and is plotted against Sommerfeld's criterion, S.

$$S = \frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2 \qquad (1)$$

where μ = viscosity in poises
n = speed, in revolutions per second
p = pressure, in dynes per square centimeter
$\frac{d}{2\Delta}$ = ratio of diameter of journal to difference between diameters of bearing and journal.

These units have been used in calculating S throughout this paper.

In the first series of tests, with speed of 111 r.p.m. and pressure of 714 lb. per sq.in. (50.2 kg. per sq.cm.), three oils were selected, a mineral oil of paraffine base, a second of naphthene base, and cottonseed oil, and all three were diluted with 300 deg. mineral seal oil, or in some cases with kerosene and gasoline, in order to vary the viscosity. The results are shown in Fig. 1, the minimum coefficient of friction being 0.00094 at a value of $S = 0.00173$ for a mixture of petroleum oil and kerosene of approximately the same viscosity as straight 300 deg. oil.

It will be noted that this value of S is much lower than the theoretical value, and it is believed that this is not due, primarily, to error in estimating the clearance, but to the fact, pointed out by Harrison,[5] that Sommerfeld's equations apply only when the friction is calculated from the moment of the journal, but that when, as is usual in friction machines, the measured moment is that of the bearing block, there is theoretically no value of S except zero, at which f is a minimum. Thus when, with decreasing values of S, the friction begins to increase rapidly, this should be taken as an indication that the oil film is ruptured and that there is metallic contact.

In a second series of tests, shown on Figs. 1 and 3, a certain 5-gal. can of a mineral oil known as "Viscolite"

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[1] A. Sommerfeld, *Z. tech. Phys.*, vol. 2, pp. 58, 89 (1921); A. G. M. Michell, *Z. Math. & Phys.*, vol. 52, p. 123, (1905) (in English); H. T. Newbigin, *Engineering*, vol. 108, p. 861 (1919).

[2] R. E. Wilson and D. P. Barnard, 4th, *Jour.*, S.A.E., vol. 11, p. 49 (1922).

[3] B. Tower, *Proc.*, Inst. M.E., p. 651 (1883).

[4] *Chem. & Met.*, vol. 28, No. 7, p. 302.

[5] W. J. Harrison, *Trans.*, Cambridge Philosophical Soc., vol. 22, p. 39 (1913).

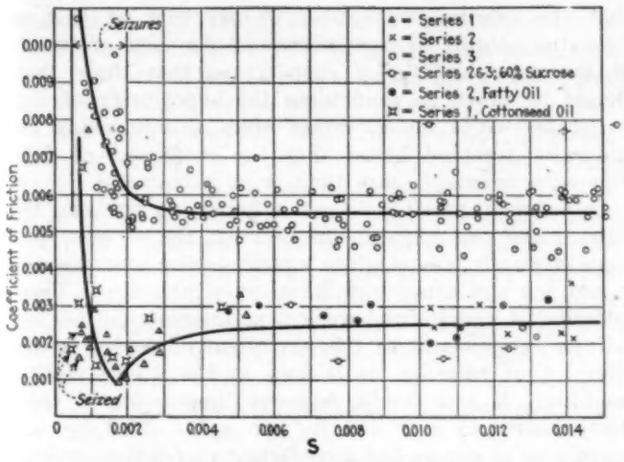


FIG. 1—FRICTION TESTS, SERIES 1 TO 3, NEAR POINT OF MINIMUM FRICTION

was selected as a standard of comparison, so that by a repetition of tests under the same conditions it would be shown whether an apparent change in friction due to changing oils was due to variations in oiliness or to change in smoothness of the rubbing surfaces. The pressure was the same as in series 1, but the speed was varied.

The tests failed to show any superiority of fatty as compared with mineral oils, or even as compared with sucrose or glycerol solutions. The minimum value of the coefficient of friction was 0.00152, or somewhat higher than in series 1, and happened to be obtained with 60 per cent sucrose solution with a viscosity of 0.37 poise, the speed being 62 r.p.m. The point of minimum friction was, however, not reached in this series.

In series 3, shown in Figs. 1 and 4, most of the tests were made with Viscolite diluted with kerosene. In general the coefficient of friction, or location of the characteristic curve, is higher than in series 1 and 2, and the marked increase in friction, due to metallic contact, occurs at a higher value of S. The tests of this series, shown in Fig. 4, were not concordant enough to indicate the slope of the characteristic curve, and this was estimated from a few tests, made toward the end of the series, with blends of Viscolite and steam engine cylinder oil. The high friction in these tests may be due to failure of the highly viscous lubricant to reach the rubbing surfaces in adequate amounts.

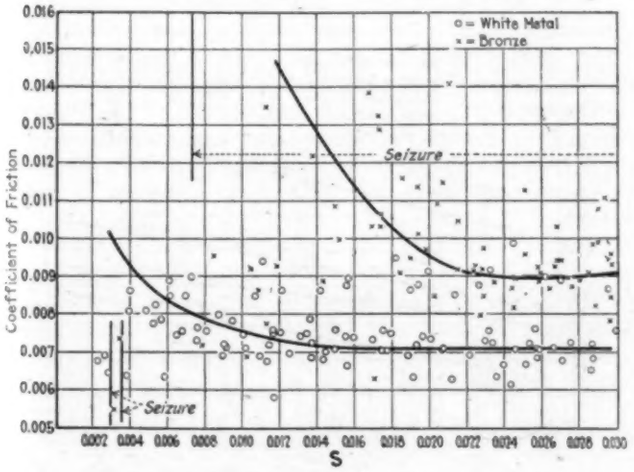


FIG. 2—FRICTION TESTS, SERIES 4, NEAR POINT OF MINIMUM FRICTION

TABLE I—SERIES 3 OF FRICTION TESTS UNDER CONDITIONS OF SEIZURE

Test No.	Viscosity, μ, Poise	Speed, R.p.m.	Pressure, Lb. Per Sq.In.	Pressure, Kg. Per Sq.Cm.	Coefficient Of Friction	Sommerfeld's Criterion, S	Lowest Value Of S Without Seizure With Same Lubricant
Lubricant: Viscolite and Kerosene							
27	0.056	52	572	40.2	.....	0.00132	0.00164
28	0.045	52	286	20.1	0.01700	0.00199	0.00158
28	0.047	87	714	50.2	0.00736	0.00138	0.00158
29	0.034	45	286	20.1	0.01760	0.00129	0.00121
29	0.034	87	714	50.2	.....	0.00100	0.00121
Lubricant: Viscolite, Kerosene and Gasoline Blend							
30	0.007	170	572	40.2	.....	0.00050	0.00067
30	0.010	116	429	30.2	.....	0.00065	0.00067
30	0.009	87	286	20.1	.....	0.00066	0.00067
30	0.009	45	143	10.1	.....	0.00068	0.00067
Lubricant: Viscolite Blended With 15 Per Cent Steam Engine Cylinder Oil							
34	1.24	50	714	50.2	.....	0.0210	0.0262
34	1.06	50	572	40.2	.....	0.0224	0.0262
34	1.12	50	572	40.2	0.00582	0.0237	0.0262

Of special interest are the tests in which seizure occurred, concerning which data are given in Table I. The limits of S between which seizure occurred have been indicated on Fig. 1. Seizure would of course have occurred at values of S below the lower limit, which

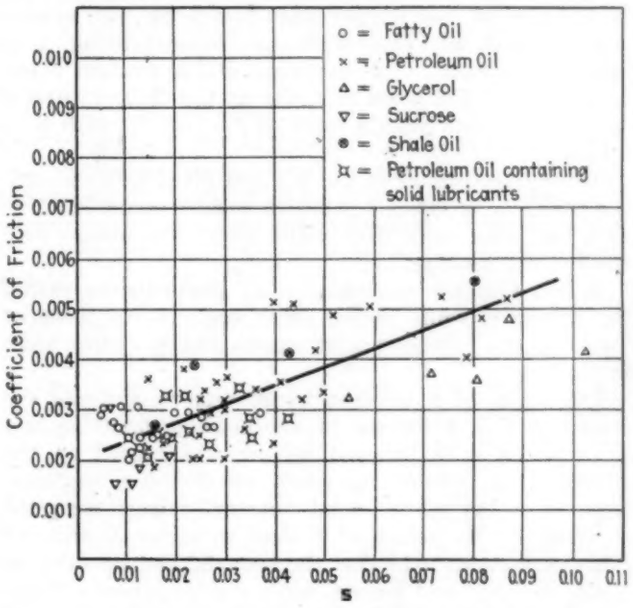


FIG. 3—FRICTION TESTS, SERIES 2, ABOVE POINT OF MINIMUM FRICTION

merely indicates the boundary of the region in which the attempt to measure friction was made.

Leaving the last three lines of the table out of consideration, it will be seen that the maximum value of S at which seizure occurred was about half its value at the point of minimum friction. Series 1 shows a very similar result. It should be noted in considering the last column of the table that these values were not calculated from momentary observations, but each speed and pressure was maintained until a constant difference of temperature between the room and bearing was reached. Presumably if smaller increments of pressure, speed and viscosity had been used, lower values of S could have been reached without seizure, but even under the conditions of the investigation seizure sometimes occurred at higher values of S than the lowest attained.

In series 4 a comparison was made between the white metal bearing used in the previous tests and the regular bronze bearing supplied with the friction machine, a variety of lubricants being used as in series 2. Both

TABLE II—SERIES 4 OF FRICTION TESTS UNDER CONDITIONS OF SEIZURE

Test No.	Lubricant	Viscosity, Poise	Speed, n, R.P.M.	Pressure p Lb. Per Sq.In.	Pressure p Kg. Per Sq.Cm.	Sommerfeld's Criterion, S	Lowest Value Of S Without Seizure With Same Lubricant
31	50 per cent cutting	0.135	53	572	40.2	0.00303	0.00403
32	60 per cent cutting	0.298	54	714	50.2	0.00545	0.00681
30	50 per cent cutting	0.110	113	214	15.1	0.0140	0.0166
30	50 per cent cutting	0.113	53	129	9.0	0.0112	0.0166
37	Used sperm	0.252	51	429	30.2	0.00724	0.0105
33	60 per cent cutting	0.287	114	286	20.1	0.0277	0.0258
42	Cottonseed	0.43	51	429	30.2	0.0123	0.0185
25	Petroleum oil with graphite	0.65	54	572	40.2	0.0148	.0198
1	Viscolite	0.98	47	543	38.2	0.0205	0.0223
5	Viscolite with 10 per cent cylinder oil	1.62	52	572	40.2	0.0356	0.0434
19	Petroleum oil	0.1278	50	286	20.1	0.00540	0.00794
19	Petroleum oil	0.1140	117	429	30.2	0.00752	0.00794

speeds and pressures were varied. The results in Fig. 4 show a higher friction than in series 3, and a higher friction with bronze than with white metal. Using increments of 143 lb. per sq.in. (10.1 kg. per sq.cm.), a pressure of 572 lb. per sq.in. (40.2 kg. per sq.cm.) was reached only once with the bronze bearing, with speed of 56 r.p.m. The lubricant was a straight petroleum oil of 0.872 poise viscosity at the temperature of the bearing, and gave a value of $f = 0.0120$ with $S = 0.0207$.

Table II is similar to Table I and gives data concerning the tests in series 4 in which seizure occurred. The first two tests were with white metal, the others with the bronze bearing.

In test 1 seizure was obtained by gradually increasing the pressure, while in the other tests, as in those of Table I, the increments of speed and pressure were fairly large.

The limits of S between which seizure occurred are shown on Fig. 4 for the bronze bearing, omitting test 5, in which it is believed seizure was caused by the oil being too viscous to reach the rubbing surfaces. Even with the white metal bearing, seizure occurred at much higher values of S than in series 3, and the evidence appears to be that the material and smoothness of the bearing and journal have a much greater influence upon the point of seizure than does the nature of the lubricant. It will be noted that seizure took place with fatty oils on a bronze bearing at a value of S two or three times as high as could be reached without seizure on a white metal bearing, using an emulsion of 50 per cent soluble cutting oil as a lubricant.

Superiority of White Metal

To determine whether the difference in friction between the white metal and the bronze bearings was due to a difference in radius of curvature or of film thickness, careful measurements were made of both bearings. No difference would be detected, the radius varying from 1.873 to 1.875 in. on either bearing. It might of course be considered that the advantage of the white metal bearing was due to superior smoothness or fit, or to the lubricating power of the lead contained in it, but the possibility of obtaining a good fit with a given metal is just as truly a characteristic of that metal as any peculiar lubricating property which may be ascribed to it.

Other tests made with this same white metal[9] showed that the friction was about 60 per cent of that of "genuine babbitt of composition 89 per cent of tin, 7½ of antimony and 3½ of copper," so that these tests should be taken as confirming the superiority of this particular white metal, rather than as disproving the generally accepted belief that the coefficient of friction with bronze is less than with babbitt.

In order if possible to get a better fit between the journal and the white metal bearing, the attempt was made to run in a new white metal bearing by reversing it end for end after each increase of pressure. Theoretically, if the journal were a mathematically perfect cylinder, this would be the equivalent of reversing the direction of rotation, as is done in the Riehlé testing machine. It was found, however, impossible to raise the pressure to over 429 lb. per sq.in. (30.2 kg. per sq.cm.) or to get as low a coefficient of friction as with the white metal bearing previously employed.

Explanation of Tower's Results

It is noteworthy that Tower obtained complete film lubrication with a machine similar to the Cornell except in length of arc of contact and in absence of reciprocating motion of the journal. Tower says of his machine: "A railway axle has a continual end play while running which prevents the brass from becoming the perfect oil-tight fit which it became in this apparatus."

To test this point, the eccentric which imparts the reciprocating motion to the journal was disconnected and the journal held rigidly in position as far as end play was concerned. A new journal was made of hardened steel and was provided with a magnolia metal bearing. With this new equipment the coefficient of friction was found at first to be about 0.009, as with the bronze bearing, but after 3 days' running it increased about 50 per cent, and examination showed that the bearing had worn in ridges which were easily visible and could also be perceived by the sense of touch. The tests were accordingly discontinued.

The most plausible explanation seems to be that Tower obtained complete film lubrication, which could not be obtained with the Cornell machine, because he had a longer bearing and a greater arc of contact, rather than because he had a better fit between bearing and journal.

If, as the above-described tests appear to indicate, the value of S at the point of minimum friction is decreased as the smoothness is increased, it might be

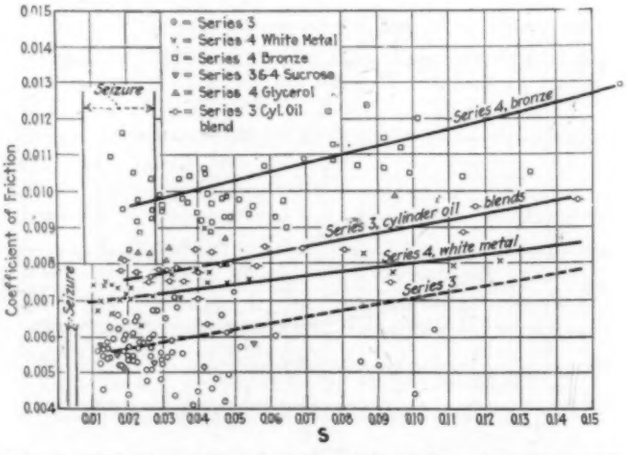


FIG. 4—FRICTION TESTS, SERIES 3 AND 4, ABOVE POINT OF MINIMUM FRICTION

[9] G. K. Burgess and R. W. Woodward U. S. Bureau of Standards Technologic Papers, No. 109 (1919).

expected that S would vary with the oiliness of the lubricant or with its ability to smooth over inequalities in the rubbing surfaces. This replacing of the rubbing surfaces with new, smoother surfaces is undoubtedly the action of graphite,[7] and the adsorbed films from oils of good oiliness might be assumed to have a similar effect. Wilson and Barnard, basing their opinion upon the tests of Archbutt and Deeley[8] and of Heimann,[9] conclude: "The use of lubricants of high oiliness tends to lower the critical point, probably because the presence of an adsorbed semi-solid film on the metal surfaces helps to prevent rupture of the fluid lubricating film, even after it has become extremely thin."

Fig. 5 shows characteristic curves for various bearings, including those from Figs. 1 to 4, and the results

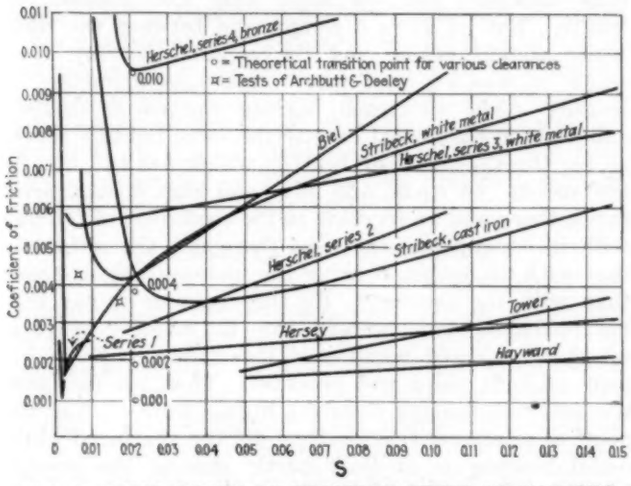


FIG. 5—COMPARISON OF FRICTION TESTS OF VARIOUS EXPERIMENTERS WHERE CLEARANCE WAS UNKNOWN

of Biel, shown separately in Fig. 6. Data concerning tests of Hayward, Tower, Hersey and Stribeck[10] were scaled from diagrams of Wilson and Barnard. Lasche's[11] tests have been omitted, because they covered only high values of S.

Examination of Wilson and Barnard's curve from tests of Archbutt and Deeley shows that the data were taken from table XCI E, assuming that tests were made at 60 deg. F., the temperature for which viscosities are given. Archbutt and Deeley do not state that this was the temperature of friction tests, and the present writer was unwilling to make this assumption and accordingly has omitted these tests from Fig. 5. Only in the case of tests with special red engine oil and rapeseed oil, in table XCI D, did it seem possible to identify the oils and to determine the viscosity at the temperature of the oil film, from data given elsewhere in the book. These two points are shown on Fig. 5, but merely serve to indicate the coefficient of friction at points presumably not very far from the point of minimum friction. For all curves of Fig. 5, $\frac{2\Delta}{d}$ was assumed to be equal to 0.001.

It will be noted that although there is considerable variation in the value of S at the point of minimum friction, the average is not far from the theoretical value of 0.0211 at the transition point for any clearance. This tends to prevent detection of the error, pointed out by Harrison, in applying Sommerfeld's formula for transition point to friction tests where, theoretically, there should be no point of minimum friction, and the critical point actually observed is due to rupture of the film and metallic contact.

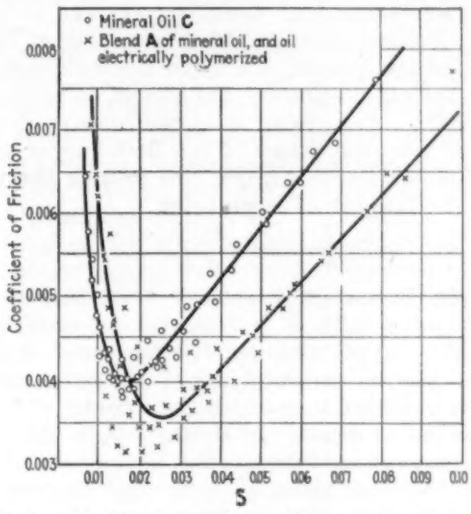


FIG. 6—FRICTION TESTS ON TWO OILS BY BIEL

In Fig. 7 are shown the very few tests in which all data, including clearance, are given. Kingsbury[12] gives complete data concerning his tests with a compressive lubricant, air, but special formulas, given by Harrison, are necessary, and these tests have been omitted from Fig. 7.

Both Heimann and Hersey state that $\frac{2\Delta}{d}$ is equal to 0.004 (although Hersey[13] adds the caution, "when the

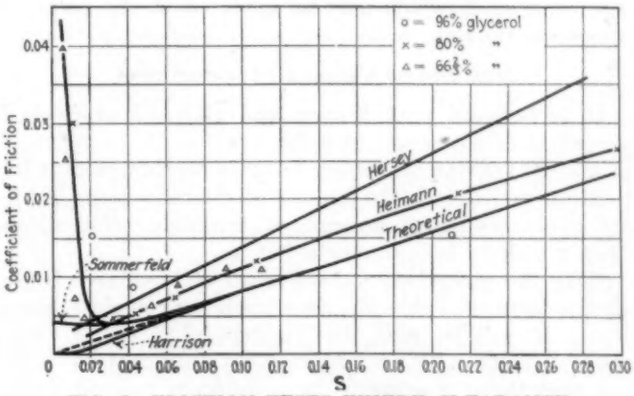


FIG. 7—FRICTION TESTS WHERE CLEARANCE WAS KNOWN

bearing was new"), and this makes it possible to compare the slope of the experimental curves with the theoretical slope. The necessary equations are given by Sommerfeld and by Harrison and may be written

$$\beta = \frac{2\pi a^2}{\sqrt{a^2-1}(2a^2+1)} \qquad (2)$$

$$S\beta = \frac{1}{6} \qquad (3)$$

$$f = \frac{2\Delta}{d}\,\frac{(a^2+2)}{3a} \qquad (4)$$

$$f = \frac{2\Delta}{d}\,\frac{(a^2-1)}{3a} \qquad (5)$$

[7] See for example, C. F. Mabery, *Jour.*, A.S.M.E., vol. 32, pp. 163-803 (1910).
[8] L. Archbutt and R. M. Deeley, "Lubrication and Lubricants," pp. 190, 385, 387 (1912).
[9] H. Heimann, *Z. Ver. deut. Ing.*, vol. 49, p. 1226 (1905).
[10] R. Stribeck, *Z. Ver. deut. Ing.*, Ingr., vol. 46, p. 1341 (1902).
[11] O. Lasche, *Z. Ver. deut. Ing.*, vol. 46, p. 1181 (1902).
[12] A. Kingsbury, *Jour.*, Am. Soc. Naval Engineers, vol. 9, p. 267 (1897).
[13] M. D. Hersey, *Jour.*, Washington Academy of Sciences, vol. 4, p. 549 (1914).

In using the above equations it is simplest to assume values of a, the ratio of the radial clearance Δ to the distance between centers of bearing and journal, remembering that $a = \sqrt{2}$ at the transition point. When f is calculated from the moment of the journal, as in Heimann's deceleration tests, equation (4) should be used in connection with equations (2) and (3), giving a curve concave upward. If f is calculated from the moment of the bearing cap, as in Hersey's tests and is usually the case, equation (5) should be used instead of equation (4), giving a curve concave downward except at very low values of S. Both curves approach asymptotically to the straight line passing through the origin, the tangent of slope being

$$\frac{f}{S} = 2\pi^2 \left(\frac{2\Delta}{d}\right) \qquad (6)$$

For the Bureau of Standards tests in Fig. 5, the variation of f with S is indicated by straight lines above the point of minimum friction, but it is realized that the law of variation might be more accurately indicated by curved lines which the accuracy of tests was not sufficient to detect. In Hersey's tests also there is no indication of curvature. But in the great majority of tests, including those of Tower and Hayward when considered over a wide enough range, the curves are concave downward.

In Figs. 6 and 7 the points merely indicate the places at which data were scaled from the original diagrams. It will be seen that even in Heimann's tests, where, theoretically, equation (4) should apply, end leakage or other circumstance not considered in the equation has caused the curves to be concave downward. Fig. 7, where the clearance is known, as well as Fig. 5, where it is assumed, both show that the theoretical transition point serves fairly well to indicate the average value of S which may be expected at the point of minimum friction.

Results of Various Investigators

It is believed that Wilson and Barnard overlooked the effect of clearance upon the location of the point of minimum friction in coming to their conclusion that its location varied with the oiliness of the lubricant. Table III gives the small amount of available information upon which to base a conclusion.

With the exception of the Bureau of Standards tests, all the tests of Table III were made on complete bearings. It will be seen that in general S varies from about 0.02 to 0.04 no matter what lubricant is used, but that there appears to be a tendency toward lower values of S when the bearings are short. Hersey is the only experimenter to get a low value of S with a long bearing. While it might be expected that the bad effects of leakage would be more noticeable with a short bearing, it is possible that this is compensated for by the greater ease of getting a good fit on a shorter bearing.

Biel compared a mineral oil with a blend of electrically polymerized oil with mineral oil, expecting to show that the blend had superior oiliness. It will be noted that the blend did show a lower coefficient of friction, but the value of S at the point of minimum friction was higher than with the straight mineral oil.

Stribeck's comparison of a cast-iron and a white metal bearing is difficult to interpret, because the former was 3.29 diameters and the latter only 1.00 diameter in length. But he gives a comparison between the short white metal bearing and the original bearing from which it was cut and which was 1.96 diameters in length: "The shortened bearing showed at medium and high speeds almost exactly the same friction curves as for the 137-mm. long bearing which was run in. At low speeds (64 r.p.m. and less) and high enough pressures, there was an increase in the coefficient of friction with increasing pressure, and there was the difference that with the longer bearing the increase began sooner than with the shorter." He then goes on to say that his published data concern only the shorter bearing, which he selected because of the wider range in his tests of both speed and pressure. Thus the fact that the cast-iron bearing showed a higher value of S at the point of minimum friction than did the shortened white metal bearing is at least partly due to the greater length of the cast-iron bearing.

TABLE III—VALUE OF SOMMERFELD'S CRITERION, S, AT POINT OF MINIMUM FRICTION

Experimenter	Ratio Of Length To Diameter Of Bearing	Assumed Clearance, $a/2\Delta$	Metal Of Bushing	Lubricant	Coef. of Friction	S
Heimann	1.67	0.004	Bronze	96 per cent glycerol	0.0087	0.0422
Heimann	1.67	0.004	Bronze	80 per cent glycerol	0.0047	0.0321
Heimann	1.67	0.004	Bronze	66⅔ per cent glycerol	0.0047	0.0161
Hersey	3.00	0.004	Brass	Mineral and fatty oils	0.0030	Note
Stribeck	3.29	0.001	C. I.	Mineral oil	0.0035	0.0315
Stribeck	1.00	0.001	White	Mineral oil	0.0016	0.0024
Biel	1.14	0.001	White	Electrically polymerized mineral oil	0.0035	0.0250
Biel	1.14	0.001	White	Mineral oil	0.0040	0.0170
Herschel						
Series 1	0.93	0.001	White	Mineral and fatty oils	0.0009	0.0017
Series 3	0.93	0.001	White	Mineral and fatty oils	0.0055	0.0040
Series 4	0.93	0.001	White	Mineral and fatty oils	0.0070	0.0140
Series 4	0.93	0.001	Bronze	Mineral and fatty oils	0.0090	0.0220

Note: A value of 0.0086 was attained without reaching the point of minimum friction.

Conclusions

The conclusion which may be drawn from Table III is that there is little or no evidence available to show that the value of S at the point of minimum friction decreases as the oiliness improves. If the location of S does vary with the oiliness, this variation could be detected only with a friction machine, possibly of the disk type, in which wear of the rubbing surfaces would not cause a variation in smoothness or of clearance during the series of tests necessary to locate the point of minimum friction.

It is believed that the present paper justifies the following conclusions:

1. There is little probability that a journal friction testing machine will ever prove convenient for testing oiliness, because the clearance changes with wear.

2. There is no experimental evidence that the value of Sommerfeld's criterion at the point of minimum friction varies with the oiliness.

Lignite Utilization

Experiments have recently been made at the lignite utilization plant at Bienfait, Sask., for the purpose of testing a special retort designed at the Bureau of Mines in Washington, as the process of the Canadian Lignite Utilization Board has proved too delicate. The form of carbonization which is being tested at the Beinfait plant has been tried out in the United States with satisfactory results. It is believed that when the Canadian Lignite Utilization Board has completed the work for which it was established low-grade lignites can be placed on the market in healthy competition with anthracite.

Technical Education In Metallurgy

By Carle R. Hayward
Associate Professor of Metallurgy, Massachusetts Institute of Technology

IT IS DIFFICULT to say anything new about technical education, yet every conference on the subject, such as that held in New York on Feb. 21 by the Mining and Metallurgical Society of America and the A.I.M.E., stimulates interest, and even old ideas dressed in new phraseology and marshaled in a new order help to crystallize conviction on the subject.

The scathing statements regarding metallurgical courses in recent editorials in *Chemical & Metallurgical Engineering* and repeated by Mr. Thum with additions at the conference referred to above cause some of us to think, even if we don't agree with them. The experiences of men like E. P. Mathewson with large numbers of metallurgical graduates is evidence that must be considered in making final decisions, while the long years of experience of teachers like President McNair must also be weighed very carefully.

Problems of Education

The writer is a teacher because he likes teaching and the satisfaction which comes from helping to prepare young men for their life work. It is probably fair to say that a majority of men have the same motives in teaching. All such are continually searching for methods which will enable them to send their students out better prepared. We think and talk about the problems which confront us and are continually trying experiments to see if improvements can be found. We don't all agree on everything by any means, and it is well that we don't, but it seems fair to assume that the experienced metallurgical teacher knows more about the problems of teaching than the average engineer. The engineer specifies certain qualities in his materials, but he usually leaves the methods of manufacture to the manufacturer. Why not apply the same principles in educating men to meet given requirements?

There is one point which must always be considered. It is one of the greatest problems in education. The manufacturer can go into the market and select his raw materials, while the school must take whatever comes to it after going through forms of examination which everyone recognizes are inadequate. Give us some method of selecting our stock that is as accurate as the manufacturer uses in selecting his raw materials and our finished product will not need the apologies that much of it gets now. Furthermore, the steel maker can take an ingot and with mathematical precision roll it to a given shape and size, but if anyone has the illusion that a technical school can perform a similar process with a student he has little conception of teaching.

There are four major subjects of discussion regardin technical education: 1. What should be taught? 2. How should it be taught? 3. How long should the course be? 4. Who should be admitted to technical schools?

What Should Be Taught?

Practically everyone is agreed that every branch of engineering requires a thorough grounding in mathematics, and although there is not complete unanimity on the subject, probably most would agree that the metallurgist should go at least through calculus. It is becoming increasingly evident that the chemical training of the metallurgist should include a thorough course in physico-, thermo- and electrochemistry if he is to be adequately fitted to cope with leaching and electrodeposition problems and the pressing problems of furnace efficiencies. The metallurgical engineer should also know something of mechanical engineering and electrical engineering, but it is a mistake to attempt to make him a designer of mechanical or electrical machinery. With a thorough grounding in physics and chemistry, enough mineralogy and geology to understand the sources of his raw materials, a very brief course in mining to give him a background for first costs and a course in ore dressing the student is prepared for his study of metallurgy proper.

Certain principles of metallurgy are doubtless taught in all schools; beyond that there is inevitably a wide divergence in practice. Some stress copper, some gold and silver, some iron and steel, each with good reason. Some have much laboratory work, some very little; probably the proper amount lies between the two extremes. At M.I.T. we require a well-balanced course covering the entire field of metallurgy and then allow optional specialization along either ferrous or non-ferrous lines. An increasing demand for principles of accounting and economic consideration of processes must have an effect on metallurgical instruction and will inevitably modify some courses. The Massachusetts Institute of Technology has from the first insisted on a certain minimum of so-called general or cultural subjects, which necessarily cut the time allowed for technical subjects, and careful thought is necessary to make this limited time count to the greatest advantage. Nonessentials must be eliminated and the students given a proper perspective.

How Should It Be Taught?

First and foremost a subject must be made interesting. Any art or artifice to bring this about is legitimate. Time spent in trying to instruct a class that is not interested is practically wasted. The student should be taught to use the library freely, not as a slave driven to a task but with a real thirst for knowledge that has been stimulated in the laboratory or the class room. Successfully to stimulate this interest is extremely difficult, but on it hangs success or failure as a teacher. The metallurgical laboratory can never teach practice, but it is invaluable for illustrating principles; here also the research spirit may be developed and the two words "Why" and "How" should be ever kept in the ears and minds of the students.

It is unfortunately necessary to devote a large proportion of the class-room time to teaching facts and describing operations, but the writer has found that the time which is most profitably spent is that used in discussing reasons for various operations. A class which can be induced to give theories or explanations of existing processes or suggestions for possible improvements in procedure or apparatus is doing some real thinking and even the most severe critics of present technical education agree that this is one of the most important things which should be accomplished.

It has been suggested that different branches of metallurgy be taught by bringing in specialists in each of these fields. The objection to this is that few of the specialists know how to teach or how to dress up their subject in a way in which it can be assimilated by the student who knows nothing about it in advance. A far

better way would be to have such specialists give one or two lectures after the student has learned the fundamentals of the subject from his regular teacher. In most cases these eminent specialists can do more good by speaking informally to the students about their personal experiences than by giving a formal lecture. We have tried both methods at M.I.T. and I feel sure that this is true.

How Long Should the Course Be?

There are many arguments in favor of taking a college course before attending technical school, especially if the student is ready for college by 16 or 17. Also in the exceptional case where a student knows definitely what line of work he is to follow on graduation an additional year of specialized technical study may be wise, but after weighing all the evidence that has come to my attention I am convinced that for the vast majority of students it is wise to start on life's real problem at once after 4 years of technical training. The metallurgical graduate who is going into the producing end must start at the bottom of the ladder. If he is too old or has spent too long a time in school, he does not adapt himself as readily to the trying conditions under which he must begin his career and thus labors under a severe handicap. The 4-year man who has been properly trained has a good technical foundation. If he has the right stuff in him, he will erect a durable superstructure on this foundation. If he hasn't the right stuff in him, a few additional years in school will do him little or no good.

Summer work in plants should be urged or required. Visits to various plants are desirable and it may be advantageous to work out a co-operative arrangement whereby certain work is done at plants under direct supervision of instructors.

Who Should Be Admitted to Technical Schools?

Some come because their parents want them to. Some because they expect to acquire great wealth in the engineering profession. Some because they think they will like engineering subjects. Some because some friends have gone or are going. About 50 per cent fall by the wayside before the degrees are conferred. Fifty per cent or more of the remainder do not practice engineering or amount to little in the profession. A small percentage become eminent or reach the goals they seek. Why did the first 50 per cent fail? The reasons are many and need not be enumerated. Many were improperly prepared and were unable to overcome the handicap. Should they have been excluded? Perhaps so, but many a man with inadequate preparation has finished with distinction. Many were wholly unfitted for engineering work. Should they have been excluded? They probably would have been if we knew fully how to apply intelligence tests, yet even many of these have received some benefit from their experience. Many have just ordinary ability and no amount of education will increase it. Should they be excluded? Some think so, but most of us think they have a right to all they can get and we can offer them.

What a joy teaching would be if we had to deal only with a handful of picked men! What encomiums would be heaped on the institutions whose alumni were all enrolled in "Who's Who"! Apparently this is the result expected by some of our critics, but there are some facts which should not be forgotten: 1. An engineering education is not wasted just because a man does not follow engineering as a profession. 2. No school can produce finished engineers. The patience and co-operation of industrial organizations is necessary to produce a finished product. 3. The biggest factor in ultimate success is a man's personal characteristics and mental ability. Such men will become successful without a technical training. The school can merely enhance that success. 4. Even at graduation there is no way yet available to predict surely the future success of the student. Often the least promising has undiscovered powers which will send him ahead of his apparently more able companion. Furthermore it should be pointed out that although curricula differ widely, men from different schools are everywhere coping successfully with the problems which confront them in greatly diversified fields.

All the above and many other points should be considered before criticising too harshly our technical schools. Their graduates are doing a magnificent work and many of them freely give fair credit to the schools. There will always be room for improvement, and improvements will continually be made if employers of graduates will co-operate in a broad and liberal spirit with those who are trying hard to turn out men who will fit in to a multitude of positions in a multitude of plants to the honor and profit of all concerned.

Use of Flash in Forgings

In the course of a lecture delivered before the British Association of Drop Forgers and reported in *The Engineer*, Leslie Aitchison pointed out that if the steel for making a forging was cut too short or of too small stock superfluous steel will not be forced out between the dies in sufficient quantity, and consequently there will be little or no flash. This might appear to be a benefit; actually it is a very serious danger because there is no cushion of steel between the dies. As a result the dies come together on their faces and mutually give each other a blow which is frequently of sufficient intensity to break one of them or badly damage some portion of the cylinder.

If too much steel is taken to make the forging, there is a gross waste of material. Excess steel is forced out between the dies in a comparatively thin squirt. This fin of metal is in close contact with the upper and lower dies, and consequently becomes chilled fairly rapidly, and the excess of material lying in the pattern cannot easily be squeezed out. A further consequence is that as the scrap becomes cold very readily it tends to split under the impact of the dies. The splits in the flash tend to spread inward and may actually proceed into the stamping itself.

Production of Rolled Zinc in 1922

The reports made to the United States Geological Survey by producers show that the output of rolled zinc in the United States in 1922 gained 76 per cent over that of 1921. At the beginning of 1922 the market quotation on rolled zinc in mill lots at the rolling plants was 8.5c. a pound, declining to 7.5c. by the middle of the year and rising to 9.5c. at the close of the year.

The large imports of zinc, which were a feature of the first half of 1921, were not repeated in 1922. Approximately 400 tons was imported during the early part of the year. The average declared value at the foreign mills was 7.1c. a pound, as compared with 3.7c a pound in 1921.

Synopsis of Recent Chemical & Metallurgical Literature

"Chem. & Met.'s" List of Reviewed Publications

Below are listed the publications that are reviewed by the staff of *Chem. & Met.* The important articles are listed in the synopsis box and the most significant contributions are abstracted and published on these pages:

American Fertilizer, 1010 Arch St., Philadelphia, Pa.
Blast Furnace and Steel Plant, 108 Smithfield St., Pittsburgh, Pa.
Brass World and Platers' Guide, Elm and Duane Sts., New York.
Brick and Clay Record, 610 Federal St., Chicago, Ill.
Canadian Chemistry and Metallurgy, 57 Queen St., West, Toronto, Ont., Canada.
Chemical Abstracts, 1709 G St., N. W., Washington, D. C.
Chemical Age (New York), 381 Fourth Ave., New York.
Chemical Age (London), 8 Bouverie St., London, E. C. 4, England.
Chemiker Zeitung, Cothen, Anbalt, Germany.
Chemistry and Industry, 46-7 Finsbury Square, London, E. C. 2, England.
Chimie et Industrie, 49 Rue des Mathurins, Paris, France.
Color Trade Journal, 21 East 40th St., New York.
Commerce Reports, Department of Commerce, Washington, D. C.
Drug and Chemical Markets, 3 Park Place, New York.
Factory, 342 Madison Ave., New York.
Facts About Sugar, 132 Front St., New York City.
Federal Reserve Bulletin, Government Printing Office, Washington, D. C.
Forging and Heat Treating, 108 Smithfield St., Pittsburgh, Pa.
Gas Age-Record, 52 Vanderbilt Ave., New York.
Gas Journal, 11 Bolt Court, Fleet St., London, England.
General Electric Review, General Electric Co., Schenectady, N. Y.
Glückauf, Essen, Germany.
Illustrated Official Journal, 168 Fleet St., London, E.C. 4, England.
India Rubber World, 25 West 45th St., New York.
Industrial and Engineering Chemistry, American Chemical Society, 810 15th St., N. W., Washington, D. C.
Industrial Digest, 25 West 45th St., New York.
Industrial Management, 120 West 32nd St., New York.
Industrial Survey, Kirby Bldg., Cleveland, Ohio.
International Sugar Journal, 2 St. Dunstan's Hill, London, E. C. 3, England.
Iron Age, 239 West 39th St., New York.
Iron and Coal Trade Review, Bessemer House, Adelphi, Strand W. C. 2, London, England.
Journal of American Chemical Society, 810 18th St., N. W., Washington, D. C.
Journal of the Institution of Petroleum Technologists and Record of Transactions, 5 John St., Adelphi, Strand, London, W. C. 2, England.
L'Echo des Mines et de la Métallurgie, 7 Rue d'Offemont, Paris, France.
L'Industrie Chimique, 8 Rue de Miromesnil, Paris, France.
Management Engineering, 20 Vesey St., New York.
Metall und Erz, Berlin, S. W. 11, Königgrätzen Strasse 106.
Mining and Metallurgy, 29 West 39th St., New York.
National Provisioner, 407 South Dearborn St., Chicago, Ill.
New Jersey Ceramist, 170 Roseville Ave., Newark, N. J.
Official Gazette of the United States Patent Office, Washington, D. C.
Oil, Paint and Drug Reporter, 100 William St., New York.
Paper, 36 West 44th St., New York.
Pulp and Paper Magazine, Gardenvale, Que., Canada.
Revue de Métallurgie, 5 Cité Pigalle, Paris, France.
Revue Universelle des Mines, 16 Quai des Etats-Unis, Liege, Belgium.
Rock Products, 542 South Dearborn St., Chicago, Ill.
Rubber Age, 225 Fourth Ave., New York.
Stahl und Eisen, Verlag Stahleisen m. b. H. Düsseldorf, Schlieszfach 664.
Sugar, 153 Waverly Place, New York.
Taylor Society Bulletin, 29 West 39th St., New York.

Road Tar Specifications

Gas Journal (London) for Feb. 21 gives a rather complete review of the new specifications for tar treatment of roads which has been adopted by the British Ministry of Transport (Roads Department). Copy of the full directions can be secured from His Majesty's Stationery Office, Imperial House, King's Way, London, W. C. 2, for 1s. each.

Low-Grade Oils in Water-Gas Making

In the carburetted water-gas plant that was designed and constructed by the Fall River (Mass.) Gas Works Co. by Stone & Webster in 1922, an attempt was made to anticipate gas-making conditions that may be expected within the next decade, particularly with respect to the supply of enriching oil. A. C. Klein describes this in the *American Gas Association Monthly* for March, 1923.

Due to the present condition in the supply of petroleum and future prospects of this supply, the gas industry well may ask itself what sort of enriching oil it may have to handle in the near future. It will undoubtedly be necessary to use such distillates and crudes as cannot be economically converted into gasoline. The two principal sources of these oils will be, first, the residuum from mid-continent crudes which remains after all the fractions that can be converted into gasoline have been removed; second, topped or untopped crudes of an asphalt base such as the heavy crude California and Mexican oils which are not desirable for use in cracking plants because the gasoline yielded is low and the residuum practically unsalable. These oils are low in gravity, viscous, high in sulphur and high in coke.

Fixed Sulphur Formation

It has been found that the use of high-sulphur oils in enriching water gas results in high-hydrogen sulphide content and a high content of fixed sulphur impurity. The Stone & Webster heavy oil process is based upon the theory that the formation of such sulphur compounds takes place only in the presence of incandescent carbon. That is, the sulphur in the oil enters first into the form of hydrogen sulphide and in the presence of incandescent carbon the hydrogen sulphide is reduced and carbon bisulphide, a fixed form of sulphur, is formed. The formation of sulphur compounds in the carburetor appears to be proportional to the sulphur content of the oil used, equilibrium being reached, apparently, when the fixed sulphur in the gas is somewhat in excess of 10 per cent of the hydrogen sulphide content.

This maximum can be attained only in the presence of an excess of incandescent coke in the carburetor. This coke would be formed from the use of an oil high in coke.

This coke is formed during the carburation process and is deposited on the checkerwork in the carburetor. During the run in which it is deposited it is too cool to react with the hydrogen sulphide. If permitted to remain, however, it becomes incandescent during the succeeding blow-run and on the following run is active in the formation of carbon bisulphide. This makes it apparent that the way to keep fixed sulphur compound out of the carburetted gas is to remove the coke from the carburetor after every run,

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. Those that are of unusual interest will be published later in abstract in this department; but since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage. The magazines reviewed have all been received within a fortnight of our publication date.

Sulphate of Ammonia Manufacture. *The American Fertilizer*, March 10, 1923, pp. 25-32.

Tin Deposits in the Malay. J. B. Newsom. *Eng. & Min. Jour.-Press*, March 17, 1923, pp. 485-491.

The Laws of Crushing. J. Herman. *Eng. & Min. Jour.-Press*, March 17, 1923, pp. 498-499.

Manufacture of Varnish. G. N. Hill, *Can. Chem. & Met.*, March, 1923, pp. 60-63.

Refractory Materials (IV). *La Technique Moderne*, March 1, 1923, pp. 144-148.

Fall River Gas Plant. A. C. Klein. *American Gas Association Monthly*, March, 1923, pp. 183-191.

Facts Considered as Industrial Stabilizers. R. H. Booth. *Iron Age*, March 8, 1923, pp. 673-677.

Chrome-Nickel Steel in Track Work. F. G. Hillbard. *Iron Age*, March 15, 1923, pp. 753-757.

Retort Vacuum and Quality Control. W. H. Warren. *Gas Journal*, March 7, 1923, p. 619.

Study of the Plasticity of Paint. Eugene C. Bingham, Herbert D. Bruce and Martin O. Wolbach, Jr. *J. Franklin Inst.*, March, 1923, pp. 303-317.

Oxidation of Hydrocarbons With Special Reference to Formaldehyde Production. Part II. Action of O_2 on CH_4. T. Sherlock Wheeler and E. W. Blair. *J. Soc. Chem. Ind.*, March 9, 1923, pp. 81-86T.

hence starting each run with clean checkerwork.

Stone & Webster Process Is Used at Fall River

The water-gas installation at Fall River embodies some features of design which have been worked out especially for handling low-gravity, high-sulphur oils. A carburetor blast connection has been made 24 in. in diameter, and a meter is installed for the measurement of carburetor air used. A connection is installed between the top of the generator-carburetor angle connection and the top of the superheater. This connection is of 42-in. diameter pipe, brick lined, containing a hydraulically operated hot valve. In the lower generator connection an additional 24-in. hot valve has been installed alongside of the regular one, and the hydraulic cylinder of this valve has been interconnected with the extra 42-in. hot valve so that one valve will always be closed and the other always open.

This connection enables the generator to be isolated from the carburetor so that air may be admitted under the generator grate and to the top of the carburetor at the same time, the generator blast heating the fuel bed while the carburetor air consumes the carbon on the checker brick, thereby heating the brick. The generator gases bypass the carburetor and superheater and meet the carburetor gases at the superheater stack, where they are burned by the excess oxygen in the carburetor blast products, the heat so generated being recovered in waste heat boilers. Oils of 15 per cent coke content generate enough heat to restore the checker brick to the proper gas-making temperature. With oils of lower coke content it may be necessary to burn the generator gases in the carburetor for a short time at the end of each blow run. The system here described provides for this.

Composition and Properties of Diaspore, Bauxite and Gibbsite

High-alumina refractories may be made from three ores—diaspore, bauxite and gibbsite. Diaspore is the monohydrate of alumina, gibbsite the trihydrate and bauxite is a mixture of the two. A careful study of the composition and properties of these ores, made by Raymond M. Howe and R. F. Ferguson, has been published in the *Journal* of the American Ceramic Society, March, 1923, p. 496.

It was found that the ores vary considerably in chemical composition, except in magnesia, alkalis and titania. Their fusion points are lowered most by lime and least by ferric oxide and silica. The burning shrinkages of the minerals high in silica were lowest, while those high in ferric oxide shrank the most. Gibbsite was found to have a higher burning shrinkage than diaspore. Some general data for bauxite and diaspore are given in the accompanying table.

On page 501 of the same issue is an article by D. C. Wysor on "Diaspore Clay of Arkansas and Missouri," followed by discussions which bring out many points of interest in connection with diaspore deposits.

Hot Drawing on a Mandril

This article[1] was read by Eugene Schneider at the autumn (1921) meeting of the Iron and Steel Institute, and can be considered as a sequel to one published in the journal of that Institute in 1920, No. 2, p. 223, under the title "An Investigation of Various Forging Operations Carried Out Under Hydraulic Presses."[2]

Drawing on a mandril has for its object the lengthening of a hollow blank obtained by punching or casting, while keeping it, by means of a mandril, at the required internal section. The operation is relatively simple, but the conditions under which the work is actually carried out are but little known.

In the present contribution the relation is worked out between the resistance of the metal to displacement and the strain per square millimeter carried by the remaining section.

It is necessary, of course, that in order for a blank to be drawn the strain per square millimeter of remaining section be less than the breaking strain at the working temperature. It is demonstrated that if we operate under the same conditions of temperature and with dies whose surfaces of contact are in the same state, the resistance to displacement increases as the angle of contact between hot metal and die decreases.

The strain in the material varies according to the temperature at which the drawing is done, but is further a direct function of the elongation effected during the operation. The maximum elongation that can be given a blank is much greater as the blank becomes thinner.

In a general manner it is better to keep a little below the maximum elongation obtainable and thus avoid the consequences which may be caused by large differences of temperature.

The dies should have as nearly as possible the ideal section indicated and should be very smooth and very hard.

The punches require every care, both as to finish and quality; tool marks and rough surfaces should be scrupulously avoided. The tensile strength should be 65 to 70 kg. per sq.mm. (100,000 lb. per sq.in.).

A very large number and variety of blanks of all dimensions were manufactured and studied in this investigation and enabled the author to make numerous observations especially applicable to the needs of the shop. Following these results the method of working no longer need follow empirical lines.

[1] *Revue de Métallurgie, Mémories*, March, 1922, pp. 121-144.

[2] Abstracted in *Chem. & Met.*, Feb. 9, 1921, vol. 24, p. 269.

GENERAL DATA FOR BAUXITE AND DIASPORES

	1	2	3	4	5	6	7
Fusion point in cones	41	34	42	40	42	40	42
Shrinkage	8.3	5.5	11.6	5.8	8.4	3.7	10.2
Porosity cone 3	59.6	47.1	45.4	40.3	53.1	48.0	49.0
Porosity cone 18	42.9	31.7	38.8	36.7	8.9	31.8	46.3
Difference	16.7	15.4	6.6	3.6	44.2	16.2	2.7
Burning shrinkage to cone 3	18.0	12.7	8.2	12.2	12.2	16.7	1.3
Burning shrinkage to cone 18	42.6	30.8	29.9	16.3	55.2	38.2	16.3
Difference	24.6	18.1	21.7	4.1	43.0	21.5	15.0
Per cent H_2O	28.08	17.90	13.74	13.41	9.88	14.98	14.24
Per cent SiO_2	9.70	18.90	13.96	20.50	1.36	17.84	5.36
Per cent Al_2O_3	56.31	52.48	67.21	60.89	60.66	61.98	73.70
Per cent Fe_2O_3	3.10	4.39	0.75	0.55	23.55	1.47	2.28
Source	Ark.	France	Mo.	Mo.	France	France	Mo.

Book Reviews

Crystallization of Metals. By *Colonel N. T. Belaiew, C.B.*, published by the University of London Press, Ltd., 17 Warwick Square, London, England. 5 x 7½ in. 143 pp., with 37 illustrations in the text and 21 plates. Price, 7s. 6d. net.

Colonel Belaiew is quite well known for his researches on Damascene swords and various curious stable structures in iron and steel. He was also perhaps the first to produce Widmanstättian structure—well known in meteorites—in artificial alloys. His researches were started in 1906 at the Michael Artillery Academy, Petrograd, under the guidance of Professor Tschernoff. Having been invalided from the Russian Army during the great war, he was sent to England to serve with the inspection staff on Russian munitions. Advantage was taken of his presence in Great Britain by the University of London to enlist him as a special lecturer, and one course of these lectures forms the basis of this little volume.

The author's researches on crystallization of steel were animated by the idea of bringing into closer harmony the processes of crystallization with various areas of the iron-carbon diagram. Studying the works of Sorby, who gradually was brought from the study of the macrostructure of meteorites to the microstructure of steel, and learning how Anossoff likewise started from the macrostructure of Damascene blades, the author felt deeply impressed by the importance of macrostructure, and directed his early efforts toward obtaining large structures easily discernible with the naked eye.

In view of the growing realization that macrostructure and "fiber" have a great but not as yet understood influence on the quality of finished pieces, this little book should prove interesting reading to a large number of men charged with technical control of metallic manufacturing. E. E. Thum.

Recent Chemical & Metallurgical Patents

Production of Metal Hydrates and Gas, Including Acetylene—J. H. Reid has assigned to Thomas Q. Hogan, of Boston, his patent on a process and material for the production of sodium or potassium hydroxide, together with carbide materials "suitable for the generation of acetylene or the preparation of nitrified material" and also simultaneous production of large quantity of fuel gas. This invention requires a mixture of cokable carbonaceous material (preferably bituminous coal) with either sodium or potassium feldspar in about the proportions of 100 lb. of the feldspar to 41 lb. of the coal, the feldspar and the coal having been previously reduced to a finely divided condition and intimately mingled. This mixture is subjected in retorts, such as are used in the manufacture of gas or coke ovens, to a temperature of from 1,400 to 2,800 deg. F. to convert the coal into coke and to obtain a strong coke-like aggregate of the feldspar and coke "capable of most efficient reduction in an electric furnace."

In such furnace, the material will be reduced to aluminum carbide, aluminum oxycarbide or to a material of the nature of silicon carbide, but harder than the latter, dependent upon the temperature and other conditions within the furnace. During the carbide reaction, Na_2O or K_2O will be evolved, depending upon the use of sodium or potassium feldspar, together with a gas consisting mainly of carbon monoxide.

"With the proportion of feldspar and coal as given, the most probable solid products in the electrical furnace will be $Al_4C_10SiO_3$; but, by increasing the proportion of carbon, the oxygen of the SiO_2 may be taken up, leaving aluminum silicon carbide—of the nature of carborundum, but probably harder." (1,445,645. Feb. 20, 1923.)

Coke Manufacture From Coal Blends—S. R. Illingworth's process for the manufacture of coke by heating a blend of two coals "which is such that its resinic content is not less than 5 per cent but preferably not less than 8 per cent of its weight" to a temperature not exceeding 500 deg. C. The resinic constituents are defined as those portions of the coal soluble in boiling phenol or boiling pyridine and also soluble in chloroform. (1,445,954. Feb. 20, 1923.)

Bauxite Refractory Bonded With Bentonite—For use in crucibles or furnace linings, the amount of clay required to produce a workable mix may be reduced from over 20 per cent to 5 per cent by substituting bentonite for ordinary plastic clay. (1,442,413. Zacharias Alsson, of New York, assignor of six-tenths to August Rust-Oppenheim, of New York. Jan. 16, 1923.)

Manufacture of Anhydrous Aluminum Chloride—Aluminum bromide is first formed in this process (described by Bernard H. Jacobson, of Charleston, W. Va., and assigned to E. C. Klipstein & Sons Co.) by treating small pieces of aluminum with liquid bromine in a closed vessel provided with a reflux condenser and cooling facilities for removing the heat of reaction. Through the liquid anhydrous aluminum bromide (m.p. 93 deg. C., b.p. 263 deg. C.) thus formed a stream of chlorine gas is passed, forming anhydrous $AlCl_3$ and liberating bromine vapor, which is condensed for re-use. (1,445,082. Feb. 13, 1923.)

Increasing Emulsifying Properties of Sulphite Waste Liquor—For many applications of neutralized and concentrated sulphite waste liquor, it is desirable to emulsify the liquor with various oils. While the lignonesulphonates contained in solution in the liquor are in themselves fairly good emulsifying agents for oils of fatty and hydrocarbon nature, the permanency of the emulsions is much improved by the addition of small amounts, say 1 per

American Patents Issued March 13, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,447,973—Treatment of Clay. William Feldenheimer and Walter William Plowman, London, England.

1,448,010—Artificial Magnesia Spinel and Process of Manufacture. Frank J. Tone, Niagara Falls, N. Y., assignor to the Carborundum Co., Niagara Falls.

1,448,011—Sagger Structure. Frank J. Tone, Niagara Falls, N. Y.

1,448,036—Reduction of Oxides of Metals of the Chromium Group. Richard Edgar Pearson and Eustace Neville Craig, London, England, assignors to Durelco, Ltd., London.

1,448,037—Electrolysis of Water. Rodolphe Pechkranz, Geneva, Switzerland.

1,448,038—Apparatus for the Carbonization of Woolen Rags, Combings and the Like. Vittorio Piana, Turin, Italy.

1,448,084—Method of Producing Lubricating Oils. Thomas F. Ott, Berkeley, Calif.

1,448,091 — Purification of Cellulose Ether. Paul C. Seel, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester.

1,448,110—Purification of Manganiferous Material. Harold de Olaneta, New Haven, Conn., assignor to Winchester Repeating Arms Co., New Haven.

1,448,128—Method of and Apparatus for Cracking Petroleum Products. Cornelius Kroll, Tulsa, Okla.

1,448,155 — Waterproofing Element. Karl Schutte, Rutherford, N. J., assignor to the Flintkote Co., Boston, Mass.

1,448,245—Liquid Fuel. Miguel Llompart y Valdés and Vincente Bacallas y Villar, Havana, Cuba.

1,448,246—Lubricating Oil. Edward Goodrich Acheson, New York, N. Y.

1,448,251 — Product for Dyeing and Printing Textile Materials. Marcel Bader and Charles Sunder, Alsatia, France, assignors of one-half to Durand & Huguenin, S. A., Basel, Switzerland.

1,448,276—Composition of Matter and Method for Preserving Organic Porous Materials. Max Landau, Berlin, Germany, assignor, by mesne assignments, to the Chemical Foundation, Inc.

1,448,278 — Tanning Means, Their Preparation and Use. Willy Moeller, Hamburg, Germany, assignor by mesne assignments, to the Chemical Foundation, Inc.

1,448,284 — Paint. Alonzo O. Tutt, Galena, Kan., and Levi F. Snelson, Joplin, Mo.

1,448,340—Process and Furnace for Reducing and Roasting Ores. Emil Fleischer, Dresden, Germany, assignor by mesne assignments to the Chemical Foundation, Inc.

1,448,386—Alkali and Heat Resistant Insulation. Gordon Q. Burr and John R. McClain, Wilkinsburg, and Leslie E. Frost, Pittsburgh, Pa., assignors to Westinghouse Electric & Manufacturing Co.

1,448,387—Method of and Apparatus for the Direct Synthesis of Ammonia at Very High Pressures. George Claude, Paris, France, assignor to L'Air Liquide, Société Anongme pour l'Étude et l'Exploitation des Procèdes Georges Claude, Paris, France.

1,448,390—Apparatus for Burning Pulverized Fuel. Charles P. Crawford, Salt Lake City, Utah.

1,448,391—Process of Treating or Retting and Curing Hemp, Flax, Perini, Jute or Other Fibrous Material. Harry I. Cromer, Oak Park, Ill.

1,448,421—Process of Purifying Raw Cane Juice. Carl J. J. Sorensen, Frederiksted, St. Croix, Virgin Islands.

1,448,432—Process of Dyeing Cellulose Acetate or Products Made Therewith. René Clavel, Basel, Switzerland.

1,448,512 — Method of Dehydrating Vegetable, Animal and Other Materials. George Hillard Benjamin, New York, N. Y.

1,448,514—Wet Process of Classifying Comminuted Material. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,448,515 — Treatment of Minerals. Walter O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York.

1,448,556—Synthetic Gum and Process of Making Same. James McIntosh, Norristown, Pa., assignor to Diamond State Fibre Co., Elsmere, Del.

1,448,557 — Dumbturner for Sugar-Cane Mills. Charles McNeil, Glasgow, Scotland.

1,448,571—Alloy. Andrew O'Rourke, Chicago, Ill., assignor to Crane Co., Chicago, Ill.

1,448,581—Process of Purifying Oleaginous Substances. Francis M. Turner, New York.

1,448,586—Process of Manufacturing Aluminous Abrasives. Thomas B. Allen, Hamilton, Ont., Canada, assignor to Abrasive Co., Philadelphia, Pa.

1,448,593—Method and Apparatus for Separating Water From Coal Tar. Paul Jaworski, Bismarckhutte, Germany.

1,448,643—Method for Treating Hydrocarbons and Particularly Crude Petroleum. Peter von Ditmar, Hamburg, Germany.

1,448,709—Art of Oil Distillation. John E. Schulze, Chicago, Ill., assignor to Red River Refining Co., Inc., Shreveport, La.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

cent, of sulphonates of more oily or hydrocarbon nature, as set forth by Karl P. McElroy, of Washington, D. C., in a patent assigned to Robeson Process Co., of New York. Either the free sulphonic acids or their salts may be used, the soda sludge from petroleum refining having been found particularly adaptable for this purpose. The emulsions formed with linseed oil, for example, may be used as core binders, road binders, briquet binders, etc. (1,444,844. Feb. 13, 1923.)

Treatment of Sulphite Cellulose Liquors — Neutralization of sulphite waste liquor with lime according to the usual practice has certain disadvantages. If the liquor is completely neutralized a lime organic compound separates as a bulky precipitate and the liquor is so changed as materially to decrease its adhesiveness. Furthermore, the neutralized liquor still contains acid sulphites. Jacob S. Robeson, of Pennington, N. J., in a patent assigned to J. S. Robeson, Inc., of Wilmington, Del., first sprays the unconcentrated liquor into a current of air, so that all of the free SO_2 and loosely combined sulphur are almost instantly permitted to escape or are oxidized to firmly bound condition. The liquor is then neutralized with magnesia, an excess of which precipitates only magnesium hydroxide and not an organic compound. As a result it is found that the adhesiveness of the evaporated liquor is increased. It is also possible to concentrate the liquor after oxidation to about 1.11 to 1.15 sp.gr. in the first two effects of a quadruple effect evaporator, ferment this liquor, return it through countercurrent heat exchanges to the third effect for the removal of alcohol, and complete the concentration of the residual liquor in the last effect. (1,445,603. Feb. 13, 1923.)

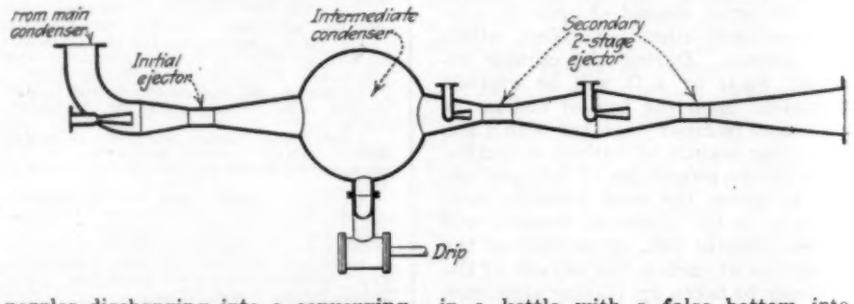
Fume Control—This invention is for the purpose of shielding, controlling and removing fumes from devices used in heating organic matter, such as paint vehicles, varnishes and similar products. When products of this type are heated, the volatile constituents are converted into fume and it is necessary to remove these fumes from the container and from contact with the residue.

These fumes are often of considerable value, and it is desirable to remove them in such a way that they may be saved and the smallest loss possible may occur. In the ordinary distillation of products such as mentioned above, the volatile portions are often decomposed by the high temperatures necessary. It has been the custom to complete the distillation of the material being distilled and still not decompose the volatile matter by resorting to a reduction of gas pressure and a consequent dropping of the temperature of distillation by the use of some sort of vacuum apparatus. The invention here discussed aims to conserve fume values and protect the fumes from destructive temperatures within the heating container and also to protect the container itself from the action of the fumes while the distillation is in process.

The method of this invention is to admit a current of air into the heating container in such a way as to form a pressure and cause the current of air to circulate over the interior surfaces of the container between the fumes which are distilled and the surfaces. This serves to protect the surfaces, and in case any portion of the fume penetrates this blanket of air, it will be sucked up to the outlet with the air and diffused. This circulation of air also enables the fume to be removed from the container without any return by condensation to the charge and without any decomposition of unstable portions of the fume. The current introduced into the container may be any other inert gas besides air. (1,446,480. Robert S. Perry and Paul W. Webster, assignors to Perry & Webster, Inc., of New York, Feb. 27, 1923).

Apparatus for Exhausting Air—The object of this invention is to increase the efficiency of apparatus used for exhausting air and liquids from condensers or other similar pieces of equipment. The improvement embodied here consists in having, as shown in the accompanying drawing, two stages to the ejector beyond the small condenser which is included in the injecting apparatus for the purpose of removing liquid from the air.

By reference to the drawing it will be noticed that this apparatus consists of an ejector, comprising a nozzle or



nozzles discharging into a converging-diverging diffuser structure, an intermediate condenser and, following this, two more ejectors exactly like the first. This differs from the usual construction of such ejectors by having two ejectors following the intermediate condenser. The inventor claims that as the result of the use of two ejectors, he is able to attain considerably more efficient operation and superior economy in steam used. It is claimed for this type of exhauster that with a pressure less than 2 in. of mercury, air can be exhausted from a main condenser with an expenditure of at least 25 per cent less steam than that used by any previous equipment. Or that with a given exhauster pressure, the improved apparatus will exhaust a far greater amount of air from the main condenser than could be done with former designs. (1,447,014. Raymond N. Ehrhart, of Pittsburgh, assignor to Elliott Co. of Pittsburgh, Pa. Feb. 27, 1923.)

Colloidal Fuel—Lindon W. Bates has been granted a patent on his mixture of liquid hydrocarbon and solid carbonaceous substance which he prepares in "a composite usable for atomizable fuel purposes" and calls a "colloidal fuel." This patent covers the product and the method of producing it. The product is described by the patentee in one of his claims as "a stable mobile atomizable liquefiable fuel comprising solid particles of carbonaceous substance, liquid hydrocarbon, and saponified resinous matter." The method of producing the product is defined in another claim as consisting "essentially in mixing liquid hydrocarbon and particles of solid carbonaceous substance in amounts which will produce a composite of specific gravity greater than that of water without destroying the atomizable character of the composite; and colloidalizing the components." (1,447,008. Feb. 27, 1923.)

Revivifying Nickel Oxide — Thomas Midgley, Jr., of Dayton, Ohio, has developed a process and an apparatus for revivifying spent nickel oxide which is used in the hydrogenation processes. This is done by treating with water and oxide (NO_2). The resulting solution contains nickel nitrate, and the nitrated material is then heated to a sufficiently high temperature to break down and drive off the NO_2 gas, leaving the oxide behind.

This oxide has been found to have the same degree of catalytic activity as that originally used. The apparatus used for carrying it out consists largely in a kettle with a false bottom into which the nickel oxide is first put and then nitrogen peroxide is bubbled up through the false bottom, converting the material into nickel nitrate. (1,446,984, assigned to the General Motors Research Corporation, of Dayton, Ohio. Feb. 27, 1923.)

Guanidine Salts—J. S. Blair and J. M. Braham have patented a process for the preparation of guanidine salts. Their process involves the use of cyanamide solutions treated with an ammonium salt under pressure. Lime nitrogen is first treated with a mineral acid and the resulting solution is heated in an autoclave at a temperature of 150 to 180 deg. with ammonium nitrate. Reaction should be completed within 3 hours under normal conditions. Good yields are reported obtained and conditions distinctly different from those specifically mentioned can be used. (1,441,206. Jan. 9, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Chromium Compounds — Chromium compounds free from iron are prepared by dissolving ferrochromium in sulphuric acid, adding calcium carbonate or its equivalent in quantity insufficient to precipitate all the chromium, dissolving out the chromium from the precipitate by an acid, such as sulphuric acid and, when chrome alum is desired, adding potassium sulphate to obtain the alum. The filtrate is treated with another quantity of calcium carbonate or the like to precipitate the rest of the chromium together with some iron and the precipitate is treated with sulphuric acid to dissolve the chromium and iron. The solution is then mixed with sulphuric acid to be used in dissolving more ferrochromium. (Br. Pat. 188,338; not yet accepted. Kinzlberger & Co., Prague, Czecho-Slovakia. Dec. 29, 1922.)

Lubricants—Derivatives of polyhydric alcohols or phenols in which the hydroxyl groups are partly replaced by fatty or other acid radicles are added to mineral oils or to saponifiable oils, fats or waxes, to increase their lubricating and emulsifying properties and to give them greater consistency. The mono-glycerides of oleic and lauric acids may be used, and in an example, 5 per cent of mono- or di-glyceride of oleic acid is added to a mineral lubricating-oil. (Br. Pat. 188,364. Technical Research Works, Ltd., and R. G. Pilly, London. Dec. 30, 1922.)

Organo-Mercury Compounds — Aromatic mercury cyanide compounds are prepared by treating complex mercury compounds of phenol and its homologues with alkali cyanides in aqueous solution, or by heating phenol and its homologues with mercury cyanide in alkaline solution or with mercuric oxide in alkali cyanide solution. The products are efficacious against plant diseases. According to examples, (1) mercury cresol cyanide is obtained by dissolving mercuric oxide in dilute sulphuric acid, adding o-cresol, boiling the resulting precipitate with sodium cyanide solution and evaporating the filtrate *in vacuo;* (2) o-cresol is boiled with mercury cyanide and dilute sodium hydroxide and the mercury cresol cyanide separated by carbon dioxide or dilute acids; (3) mercury phenol cyanide is prepared by boiling phenol with mercuric oxide in sodium cyanide solution and treating the cooled solution with carbon dioxide or dilute acids. (Br. Pat. 188,376. A Klages and Saccharin-Fabrik Akt. Ges. vorm. Fahlberg-List & Co., Magdeburg. Dec. 30, 1922.)

Gas Producer—In a gas producer the whole or part of the gases generated is carried to pass through a considerable depth, say 14 ft., of fresh fuel, which is thereby distilled in stages and at low temperature so that the gases leaving the upper part of the producer have a temperature of between 150 and 300 deg. C. and a calorific value of about 170 B.t.u., high yields of ammonia and low-temperature distillation products being obtained. The temperature of the upper fuel zone may be controlled by removing part of the gases generated in the lower part of the producer prior to their reaching the upper zone. A central gas off-take comprises a bell situated near the top of the upper zone so that the ascending gases are distributed evenly over the cross-sectional area of the descending column of fresh fuel. (Br. Pat. 188,607. W. Beswick and N. E. Rambush, Stockton-on-Tees, England. Jan. 10, 1923.)

Extracting Metals—Vapors of metallic chlorides are passed over a heated mixture of carbon and alkalis, alkaline earths or magnesia; or the vapors of the chlorides mixed with excess of a gaseous or liquid reducing agent may be passed over the alkaline substance alone. The temperature is kept sufficiently high to melt the metal and the alkali chloride, which are both discharged in a molten state. The process may be carried out in a producer charged with carbonaceous fuel and burnt or unburnt limestone or dolomite, the chloride vapor being supplied thereto mixed with air. (Br. Pat. 188,657; not yet accepted. S. J. Vermaes and L. L. J. Van Lijnden, The Hague. Jan. 10, 1923.)

Active Carbon for Drying Gases—A process of drying gases or separating mixtures of gases consists in treating them with active carbon, preferably of vegetable origin and dehydrated by ignition or by heating in vacuo before use, and in drying the gases or separating them by adsorption. One method of carrying out the invention consists in passing the gases through containers filled with granules of active carbon and arranged in series so that as one container becomes exhausted it can be cut out of the series and the saturated carbon reactivated by heated inert gas, the inert gas being passed directly into the container or into a perforated tube in the container with means for closing the perforations. The containers may be cooled to remove the heat of adsorption, the last containers of the series being cooled more than the first, and the cooled gas used for cooling the moist gas on the countercurrent principle. The drying is facilitated if the gas is compressed or its temperature reduced to about 0 to 5 deg. C. The process can be used to separate light and heavy hydrocarbons, or to remove impurities such as hydrocarbons and carbon dioxide from hydrogen. (Br. Pat. 188,666; not yet accepted. Algemeene Norit Maatschappij, Amsterdam. Jan. 10, 1923.)

Activated Carbon in Gaseous Reactions—The treatment of liquids with gases is rendered more effective by carrying out the treatment in the presence of activated carbon. The carbon is preferably obtained from vegetable raw material in such a manner that the structure of the raw material is retained. Powdered carbon may be mixed with the liquid and the mixture then treated with the gas, preferably under pressure. Or the liquid and gas may be passed in countercurrent fashion through a column of granular carbon. Or the carbon may be caused to adsorb the gas and then used to treat the liquid. Such adsorption may be secured by treating the carbon with gas under pressure at a low temperature, or with a solution of the gas in a portion of the liquid to be treated or in another liquid. The carbon may before use be treated to remove gases either by ignition or by heating in a vacuum. The process is stated to be applicable in bleaching liquids, in oxidizing drying and semi-drying oils, in the decomposition or oxidization of mineral oils for the purpose of converting them into fatty acids and other products, and in purifying and sterilizing water or other liquids with chlorine. (Br. Pat. 188,667; not yet accepted. Algemeene Norit Maatschappij, Amsterdam, Jan. 10, 1923.)

Tanning—A starch-tannin preparation is made by heating starch with a tanning extract, at or near the boiling point of the liquor but well above 180 deg. F., if necessary with the addition of a weak acid, until the starch is highly dispersed beyond the jelly stage—that is, it remains in the form of a colloidel solution and does not form a jelly on cooling. Tanning extracts of the pyrogallol class, such as chestnut wood, oakwood and myrabalans, can be used without acid, while those of the catechol class, for example mimosa bark and quebracho, require the more vigorous treatment. Weak acids specified are such as acetic, lactic, sulphonic acids and sulphur dioxide. Gallic and tannic acids may be substituted for the mixture of acid and tanning material. According to examples, Japanese farina is dispersed by vigorous boiling with myrabalan extract, with quebracho extract and sodium bisulphite or with mimosa bark and gallic acid. The preparation is applicable for tanning hides or, according to the provisional specification, for pharmaceutical purposes. Specification 110,470 is referred to. (Br. Pat. 189,236. R. R. Howroyd, Liverpool, and A. Turnbull, Helsby, Cheshire. Jan. 17, 1923.)

Formaldehyde—Formaldehyde is produced by passing a mixture of methylene chloride vapor and water vapor at a raised temperature over a porous body, such as pieces of clay, infusorial earth, ordinary or activated wood charcoal. The condensate consists of a hydrochloric acid solution of formaldehyde. (Br. Pat. 189,432; not yet accepted. Farbwerke vorm. Meister Lucius and Brüning, Hoechst-on-Main. Jan. 17, 1923.)

Varnishes and Polishes—Chlorinated montan or other mineral wax is used as an ingredient of varnishes and polishes. It may be used alone in solution or mixed with oils, pigments, other waxes and resins. (Br. Pat. 189,104. A. Schmidt, Paris. Jan. 17, 1923.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

New Haven Meeting Plans of A.C.S. Are Announced

Large Attendance Expected at Spring Gathering—Full Program Is Now Available

ANNOUNCEMENT of the final program for the spring meeting of the A.C.S. promises a session of great interest. The various divisions have arranged several symposiums in connection with the usual presentation of papers. Social as well as technical activities for the week at New Haven from April 2-7 have been carefully planned.

It is requested that on arrival all members and guests go direct to Byers Memorial Hall, where full information regarding reservations, etc., may be obtained and where registration should be made.

Outline of Monday's Events

The first day's general activities will open with a Council meeting in the afternoon, followed by a complimentary dinner given to the councilors by the New Haven Chamber of Commerce, at which the president of that body will preside. Other members may also attend, tickets being obtainable at Byers Hall. Speakers at the dinner will include the president of Yale, James R. Angell; E. C. Franklin, president of the A.C.S.; Brigadier-General A. A. Fries, and A. D. Little.

Tuesday's Meetings of General Interest

On Tuesday, the second day, a general public meeting will be held at Woolsey Hall in the morning at which Francis P. Garvan will speak on "Chemistry and the Public." In the afternoon a general scientific meeting will be held, when special addresses will be given by the following speakers: Carl L. Alsberg, "Chemistry and Our Food Resources;" C. O. Johns, "The History and Status of Petroleum Chemistry Research;" H. E. Barnard, "The Baker Turns to the Chemist;" Oskar Baudisch, "The Influence of Light on Inorganic Material and Life Processes;" W. O. Mitscherling, "Cellulose Silk;" and Arthur Hirschfelder, "The Influence of Modern Chemistry on Pharmacology."

On Tuesday evening the men are to stage a smoker at the university dining hall, while the women will visit the Shubert Theater.

Wednesday's program will be devoted largely to functions arranged by Yale University, the most important being the dedication of the new Sterling Chemistry Laboratory. The time set for this event is 11 a.m., when among other speakers Past President E. F. Smith will give a special address entitled, "The History of Chemistry in America, With Special Reference to Yale." Following a complimentary luncheon at which foreign guests will speak, the laboratory will be open to inspection. In the evening a special dinner will be in charge of the Rubber Division. At the public evening meeting Sir J. J. Thompson, F.R.S., will speak.

Special Sessions Begin Thursday

On Thursday, following the morning and afternoon sessions of the divisional and sectional meetings, there will be fraternity and college alumni dinners. The women of Iota Sigma Pi have arranged a special 5 o'clock meeting at Sheffield Hall. In the later evening entertainment will be provided by an indoor polo game of the Yale R.O.T.C. at the armory.

Friday will be given over largely to special meetings. In the evening a reception is to tendered visiting members and guests by the New Haven Section. Dancing will be in order from 9 to 12, with supper at 10:30.

Several plants in the vicinity of New Haven will be open to inspection on Saturday. Throughout the week regular and special exhibits will be on display in the various Yale halls. The ladies' time is well arranged for with several teas, auto excursions, etc., provided.

Divisional Meeting Program

Division of Petroleum Chemistry, Thursday and Friday; 19 papers.

Section of Gas and Fuel Chemistry, Thursday; 7 papers.

Division of Industrial and Engineering Chemistry, Thursday and Friday; 27 papers.

Division of Rubber Chemistry, Thursday and Friday; 15 papers.

Division of Cellulose Chemistry, Thursday and Friday; 19 papers.

Section of History of Chemistry, Friday; 12 papers.

Section of Chemical Education, Thursday and Friday; 16 papers.

Division of Water, Sewage and Sanitation, Thursday; 10 papers.

Division of Chemistry of Medicinal Products, Thursday; 8 papers.

Division of Biological Chemistry, Thursday and Friday; 38 papers.

Division of Sugar Chemistry, Thursday and Friday; 15 papers.

Division of Physical and Inorganic Chemistry, 1. Section of Inorganic and Physical, Thursday and Friday; 42 papers. 2. Section of Colloids, Friday; 12 papers.

Division of Organic Chemistry, Thursday and Friday; 63 papers.

Division of Agricultural and Food Chemistry, Thursday and Friday; 35 papers.

Calendar

The following important technical meetings are scheduled for the immediate future:

AMERICAN CHEMICAL SOCIETY
New Haven, Conn., April 2-7

AMERICAN ELECTROCHEMICAL SOCIETY
New York City, May 3-5

AMER. SOCIETY MECHANICAL ENGRS.
Montreal, May 28-31

AMERICAN FOUNDRYMEN'S ASSOCIATION
Cleveland, O., April 28-May 4

AMERICAN OIL CHEMISTS' SOCIETY
Hot Springs, Ark., April 30-May 1

AMER. SOCIETY MECHANICAL ENGRS.
Montreal, May 28-31

CANADIAN INSTITUTE OF CHEMISTRY
Toronto, May 29-31

SOCIETY OF CHEMICAL INDUSTRY
Canadian Section
Toronto, May 29-31

SOCIETY OF INDUSTRIAL ENGINEERS
Cincinnati, O, April 18-20

SOCIETY OF CHEMICAL INDUSTRY
New York, joint meeting with other societies, April 13

Educational Movies Made by U. S. Bureau of Mines

An industrial film picturing the manufacture of heavy clay products is to be made by the Bureau of Mines in cooperation with manufacturers. The bureau has been very successful in the development of other industrial moving pictures. Among those already made are: Story of Petroleum; Story of Sulphur; Story of Ingot Iron; Saving Coal at Home; Story of Asbestos; Story of Rock Drilling; Story of Abrasives; Mexico and Its Oil; Story of Heavy Excavating Machinery; Oxygen, the Wonder Worker; Story of the Electric Beater; Story of an Automobile; Story of Compressed Air; Water Power; Transportation; Story of Alloy Steel; Story of Machine Tool Manufacture; Story of Steel, and Story of Portland Cement.

Federal Restrictions Cause Action By Industrial Alcohol Users

Committee Calls on Commissioner Blair Urging Revision of Present Rules

EXASPERATION on the part of many users of industrial alcohol has been growing. Recently a committee representing the industries that have had difficulty in obtaining the supply required for their business made an earnest plea for revision of present methods of handling the situation. As a result Commissioner D. H. Blair has announced that he will name a committee representing producers, dealers and consumers in the industry to advise with bureau officials regarding all regulations and matters affecting the industry. The ultimate object of this move is to separate industrial alcohol from the general police activities of the prohibition unit and at the same time to comply with the letter and spirit of the Volstead act, which purports to provide for the encouragement of legitimate uses of industrial alcohol.

Tendency Toward Undue Restriction

It was pointed out to the commissioner that while no special complaint was being lodged against the orders or actions of Prohibition Commissioner R. A. Haynes, the tendency in the prohibition unit has been to issue restrictive regulations rather than to devote attention to the development of the legitimate business of producing, selling and using industrial alcohol. For this reason, it was suggested that the activities in this matter be placed in a special division with a technical man at its head.

Attention was called to the fact that section 13 of the Volstead act has been virtually overlooked. This section provides methods for the bonding and operation of plants manufacturing industrial alcohol, denaturing plants and such matters "to prevent diversion of the alcohol to illegal uses and to place the non-beverage alcohol industry using alcohol . . . upon the highest possible plane of scientific and commercial efficiency consistent with the interests of the government, and which shall insure an ample supply . . . and promote its use in scientific research and the development of fuels, dyes and other lawful uses."

Not only have the regulations been restrictive of development, the commissioner was told, but it has been made difficult to obtain promptly a supply required by legitimate industries.

Personnel of Committee

Included among the committee calling on the commissioner were Dr. Martin H. Ittner, of the American Chemical Society; A. Homer Smith, secretary of the American Drug Manufacturers' Association and of the National Drug Trade Conference; W. L. Crounse, of the National Wholesale Druggists Association; Harry B. Thompson, of the Proprietary Association of America; James P. McGovern, of the U. S. Industrial Alcohol Co. and the U. S. Industrial Chemical Co.; Horace W. Bigelow, of Parke, Davis & Co.; Mortimer Bye, of Frederick Stearns & Co., and others.

Resolutions of the National Wholesale Druggists Association and of the National Drug Trade Conference, asking appointment of an advisory committee, were presented to Commissioner Blair.

Blair Announces Intention to Act

In an announcement after the conference, stating that he had the appointment of an advisory committee "under consideration" and indicating that it would be approved and the personnel then made public, Commissioner Blair said that the proposal contemplated a committee of ten members representing the retail and wholesale druggists, toilet manufacturers, flavoring manufacturers and chemists representing other consumers and producers.

Fuel Utilization Discussed

Several Speakers at Chemical Industry Meeting Present Ideas

The American Section of the Society of Chemical Industry held its regular monthly meeting on March 23 at the Chemists' Club, New York City. The topic of the evening was the latest developments in the utilization of fuel.

The first of the speakers, H. O. Loebell, vice-president of the Combustion Utilities Corporation, spoke on the complete gasification of coal. Mr. Loebell's thesis was that coal, to be used most efficiently, must be completely gasified. In developing this subject he described the present systems of complete gasification, detailed the methods by which results were obtained and pointed out that a market must be found for the greatly increased production of tar that would result from complete gasification.

Prof. J. J. Morgan, of Columbia University, the next speaker, gave a description of the make-up and character of tars obtained by complete gasification and low-temperature distillation methods. This tar, he stated, may best be regarded as primary tar and is not a substitute for petroleum. A complete development of this subject by Professor Morgan can be found in *Chem. & Met.*, vol. 26, pp. 923, 977, 1025.

A. C. Fieldner, of the Bureau of Mines, the last speaker of the evening, recounted the bureau's work on producing lignite chars and described the successful experimental plant built in conjunction with the University of North Dakota. He concluded his remarks with a short account of the characteristics and methods of utilization of this fuel.

Announce Applicants for Tariff Revision

The Tariff Commission has just made public the names of the firms seeking changes in the existing tariff. As announced in last week's *Chem. & Met.* these commodities are to be especially investigated. The list follows:

Oxalic acid, Victor Chemical Works, Chicago.

Diethyl barbituric acid, Abbott Laboratories, Chicago.

Barium dioxide, increase asked by the J. H. R. Products Co., Willoughby, Ohio; decrease asked by John Bene & Sons, Inc., Brooklyn, N. Y.

Casein, committee representing various coated-paper manufacturers.

Logwood extract, American Dyewood Co., New York.

Potassium chlorate, increase asked by the National Electrolytic Co., Niagara Falls, and the North American Chemical Co., Bay City, Mich.; decrease asked by the Diamond Match Co.

Sodium nitrate, American Nitrogen Products Co., Seattle, Wash.

Boll Weevil Reports Sought by Agricultural Bureau

In its fight on the boll weevil the Department of Agriculture is preparing to send out notice to 100,000 farmers this season advising them they will be asked to give detailed information next fall as to the efficacy of the various methods of fighting the pest.

In the past the department has been handicapped by lack of detailed data as to what the relative effects of different methods are. Three expert statisticians, H. R. Tolley, D. B. Smith and D. R. Pettit, have been sent to Tallulah, La., to check over field observations of entomologists.

China to Produce Cement

China is to meet her own demands for cement. According to a report from Consul J. K. Daves, Nanking, a new plant is being erected in the Yangtze Valley. This plant, midway between the two greatest markets of China, will have an initial output of four hundred 375-lb. barrels per day. The China Cement Manufacturing Co., the first to produce in this vicinity, has invested approximately $380,000 in the enterprise.

With the completion of this plant, which is to begin operations soon, and of another in Shanghai, China's demands for cement will be met by domestic production to a large extent.

Antipodean Shale Oil Industry Fails

Due to the high cost of production the shale oil operations of John Fell & Co., in New South Wales, have been discontinued, according to official consular reports. It is stated that the cost of putting the oil on the market is approximately five times that of importing crude oil; that the small government bounty is insufficient to protect the industry. The plant which has been used in shale-oil recovery is being remodeled and will be opened in the near future as a crude oil refinery.

Standards Bureau Research Should Be Fundamental

Distinguished Board of Visitors Makes This Finding After Investigation

"It is of the highest importance to the future of American industry and scientific progress that the activities of the Bureau of Standards should continue more and more devoted to scientific research of a profound and fundamental character, beyond the means of most college laboratories, where instruction to students is the chief purpose, and that these investigations should be of a broader scope than can be expected from research and testing laboratories in the service of special industries."

The foregoing is a portion of the findings of the board of visitors to the bureau after a careful survey of the establishment's current activities. The board of visitors is composed of John R. Freeman, former president of the American Society of Civil Engineers; Ambrose Swazey, former president of the American Society of Mechanical Engineers; F. W. McNair, president, Michigan School of Mines; S. W. Stratton, president, Massachusetts Institute of Technology, and Wilder D. Bancroft, professor of chemistry, Cornell University.

"The determination of the physical constants of materials and the more thorough investigation of the properties of substance, apart from immediate applications seen in the industries," continues the report of the board of visitors, "seem particularly appropriate under the organic act creating this bureau. We venture to suggest specific appropriations in the budget for such research."

Explosion Hazard Met With Little Loss

Losses have greatly decreased in transporting explosives, according to a recent report of the Bureau for the Safe Handling of Explosives and Other Dangerous Articles. The following extract shows to what a remarkably low level this loss has been reduced:

"During the year 1922, the railroads of the United States transported 168,301 tons of commercial explosives, and in addition a very large but unknown tonnage of fireworks and salvaged war ammunition. The total losses were one man injured and $75 property loss. This is much below the average of previous records. Moreover, it is encouraging in showing what can be accomplished."

Old Explosives Being Used

Additional large quantities of surplus explosives, left from the war period, have reached the point where their value as a military reserve is becoming impaired. Steps now are being taken to allocate these supplies for use in highway building, reclamation and other construction in which the federal government is interested.

Arsenic Stays in Limelight

The attention of several government departments is focused upon the calcium arsenate situation. The production, the possible shortage and means of immediate augmentation of the supply are being looked into. The Bureau of Mines, the United States Geological Survey and the Bureau of Entomology and the Bureau of Chemistry of the Department of Agriculture are co-operating in studying the problem. This interdepartmental investigation is the outgrowth of the recent Senate resolution directing an inquiry into the subject.

Producers, manufacturers, consumers and federal bureaus are also engaged in making a study of possible means of stabilizing the arsenic market to encourage production. Data and a suitable bibliography with reference to the storage of arsenic trioxide as an intermediate material for the manufacture of calcium arsenate are being compiled by Dr. Andrew Stewart. Obtaining arsenic from ores will be studied following the investigation of the problems upon which the various bureaus are now engaged.

Italy Liquidates Sulphur Debts

In view of the agreement said to have been reached between the American Sulphur Export Association and the Italian sulphur producers, there is particular interest in the advices to the Department of Commerce that the Italian Government has guaranteed a bond issue for 100,000,000 lire. The proceeds of the bond issue are to be employed in liquidating debts contracted by the Sicilian Sulphur Consortium and the redemption of certificates issued to cover advances made on sulphur delivered during the fiscal year 1920.

The basic security for the bonds is the stock of 273,740 tons of sulphur held in the warehouses of the consortium on April 30, 1922. The consortium will calculate that one-ninth of the stock in question has been sold during each period of 12 months. In case sales exceed production plus one-ninth of the stock, an appropriate adjustment will be made. In addition, the bonds are guaranteed by the net assets of the consortium, including its reserve fund, as well as other assets of the consortium and of the individual producers of sulphur.

Tariff Board Plans Hearings

Work on the investigation of the production costs of the chemicals listed in last week's *Chem. & Met.* is under way. Although it is expected that months will elapse before the data sought are complete, plans are already being made for public hearings. Rules of procedure and regulations for government are being drawn up. As soon as any investigation is complete it is planned to give all interested parties a chance to appear in defense of an increase or decrease of the existing rate of duty.

Colloid Symposium Coming in June

Svedberg to Give Summer Course in Colloidal Chemistry—Many Noted Speakers to Be Present

Plans are rapidly maturing for the national symposium on colloid chemistry to be held at the University of Wisconsin in June. Professor Svedberg intends to follow the symposium with a course of about thirty lectures on colloid chemistry in the summer school, which commences June 25 and closes Aug. 4. Research will be continued under his direction during this period.

Since this is to be the first national symposium on this subject to be held in America, the program has been arranged with the idea of having the whole field represented as far as possible. With one or two exceptions the papers will be presented in person by the author and ample time will be afforded for discussion. According to present plans these papers and discussions will be published in monograph form. Following is the tentative program for the symposium:

Alexander, J., "The Colloidal State in Metals and Alloys."
Bancroft, W. D., "Precipitation of Sols by Alcohol."
Bartell, F. E., "Some Adsorption Studies."
Bogue, R. H., "Conditions Affecting the Hydrolysis of Collagen to Gelatin."
Browne, F. L., "Thermochemistry of Sulphur Sols."
Burton, E. F., "General Considerations of the Forces Determining the Limiting Size of the Colloidal Particle in Any Given Solution."
Fischer, Martin, "On the Theory of the Lyophilic Colloids."
Gortner, R. A., "The Application of Colloid Chemistry to Agricultural Problems."
Holmes, H. N., "Gel Formation."
Kahlenberg, L., "On the Precipitation of Colloidal Metals by Means of Metals in the Solid State."
Klein, D., "The Colloid Chemical Problems in the Manufacture of Enzymic and Animal Glandular Products."
Mathews, J. H., and Rowland, B. W., "The Thermochemistry of Protein Behavior."
Sheppard, S. E., "Dispersity of Silver Halides in Relation to Their Photographic Behavior."
Spear, E. B., "Colloidal Properties of Rubber and Compound Ingredients."
Svedberg, The, "Demonstrations of Colloid Chemistry Technique."
Taylor, H. S., "The Problem of Adsorption From the Standpoint of Catalysis."
Weiser, H. B., "The Formation of Inorganic Jellies."
Wilson, John A., "The Swelling of Protein Jellies."
Wilson, Robert E., "Surface Films as Plastic Solids."

Papers are expected from T. R. Briggs, C. W. J. Frazer, Jacques Loeb and W. A. Patrick.

Pottery Men Face Trial

The alleged "potteries combine," composed of twenty-three corporations and twenty-four individuals, faces trial in the Federal District Court. The charge, made in the form of a Sherman law indictment, is that of violation of the criminal provisions of the anti-trust law.

The indictment was returned by the United States Grand Jury on Aug. 8, last, and a month later all of the individual defendants excepting J. F. Slater and J. W. Bowers appeared and entered pleas of not guilty.

Presents American View of Rubber Situation

Horace DeLisser, President of American Rubber Association, Answers Winston Churchill

That present British policy threatens industry is the belief of H. DeLisser, president of the American Rubber Association. In a recent reply to the speech of Colonial Secretary Winston Churchill, referred to in last week's *Chem. & Met.*, he says:

"Mr. Churchill in a recent statement published in London and this country declared that the British rubber growers were 'under no obligation to supply the United States with rubber below the cost of production' and that it was 'impossible for the Colonial Office to witness the financial ruin of the rubber producing colonies owing to the continued sale of their products below the cost of production.'

No Unfairness Intended

"In the first place the Rubber Association of America, which represents 95 per cent of the rubber manufacturers in the United States, does not seek a supply of crude rubber below the cost of production, nor does the association have the slightest intention of causing or witnessing the financial ruin of plantation owners. No industry can prosper on the adversity of another.

"It is because the Rubber Association of America, the largest consumer of rubber in the world, is convinced, after a most thorough investigation, that the policy of the British colonies in restricting the exports of crude rubber threatens the whole rubber industry here and abroad, and the association is pressing the Rubber Growers' Association of London for a repeal of the restriction order or an immediate modification to permit greater flexibility in the supply of rubber.

Stevenson Plan Induces Speculation

"The Stevenson plan for restricting the export of crude rubber today threatens to introduce wide speculation in rubber prices. Its ultimate effect will be to curtail rubber production on the plantations. Such a course would be ruinous to the rubber growers.

"Members of the Rubber Association are looking forward to a greater consumption of rubber during the summer. To take care of our needs this year and in the future, it is imperative that the planting of new rubber be encouraged. This association believes that the policy of the British colonies today will be far more injurious to the plantations than to the rubber industries of this country."

Helium Plant Goes West

The helium repurification plant at Langley Field, Va., is to be moved to Scott Field, near St. Louis. This is made necessary by the fact that the army is transferring most of its lighter-than-air work to Scott Field, where conditions have been found to be most favorable.

Canadian Prairie Provinces Yielding Commercially Valuable Salts

Range of Resources Broad and Little Worked—Development Now Beginning in Several Localities

COMPARATIVELY unworked sources of mineral wealth exist in the western provinces of Canada. Areas which have been considered valuable only from an agricultural standpoint are proving to be fairly rich in non-metallic mineral resources. Clays, coal, oil, gas and the sodium and magnesium salts, which occur in the numerous alkali lakes and sloughs throughout the area, are attracting the attention of capital with the result that considerable activity is evidenced in all these lines. The increased interest in the alkali deposits of western Canada has induced the Canadian Department of Mines to institute a detailed investigation of these deposits with a view to determining their possible economic value and the extent of reserves.

Salt Deposits Already Worked

Natural occurrences of soluble mineral salts are known in the provinces of Manitoba, Saskatchewan, Alberta and British Columbia, either in the form of bedded deposits or as brines. Some are of considerable extent and are probably of sufficient size to warrant commercial exploitation, provided economical methods of recovery can be developed and sufficient markets can be established. Three of these deposits are being operated or will shortly be operated in the prairie provinces and plans are under way for the development and operation of a fourth deposit.

Salt Cake Extraction

At Dana, Sask., a half million dollar plant is nearing completion, to extract salt cake and other chemical products from the brines of Muskiki Lake, 23 miles west of Humboldt, Sask. The company operating this deposit is Salts & Chemicals, Ltd., controlled by Canadian and United States interests. The main plant of this company is at the deposit at the lake and it has a refining plant at Kitchener, Ont. When this plant is in operation it is estimated that the output will be 30,000 tons of salt cake per year besides the output of magnesium sulphate and other salts recovered as byproducts.

At Frederick Lake, 5 miles southwest of Dunkirk, Sask., and 38 miles from Moose Jaw, Sask., another salt cake recovery plant has been erected by the Bishopric & Lent Co. with headoffices at Cincinnati, Ohio. This plant is practically completed with a capacity of 50 tons of salt cake per day, and as soon as it proves commercially successful further units are to be added to increase the output to 200 tons per day.

Magnesium Sulphate and Sodium Carbonate

In British Columbia the Basque Chemical Co. is operating on a series of five lakes situated 15 miles west of Ashcroft. From these lakes the company is excavating crude magnesium sulphate, which is shipped to Vancouver, where it is refined and sold to the pharmacal trade and to the tanning industry. Plans are now under way for greatly extending the development of this deposit.

In the vicinity of Meadow Lake, 50 miles north of Clinton, B. C., the Lillooet Soda Co. is operating a sodium carbonate lake and shipping the product to Vancouver. This material is being disposed of at the present time to the soap manufacturers of the Pacific coast, but plans are under way to dry the material at the lake and increase the output.

American Relief Association Makes Announcement

The extension of the work of the A.R.A. to cover home activities has been announced by its chairman, Herbert Hoover, in the following circular letter:

Dear Friend:—I wish to bring before you, as a supporter of the American Relief Administration, a problem in connection with our own American life.

As you are aware, the American Relief Administration has at one time or another during the last four years found support necessary to maintain life in upwards of 15,000,000 children. It has thereby acquired great experience in problems of child health, which it seems to be important should be translated into American child life, more particularly in relation to the children in backward sections and in large industrial centers of the country. Our physicians report that over 80 per cent of all children in America are born normal, whereas less than 20 per cent reach maturity in normal physical health. Much constructive work has been done by public agencies and by voluntary agencies in endeavoring to develop the proper care of normal children as distinguished from the care of those who have fallen by the wayside and require actual medical treatment, but the field in many sections of our country is as yet almost untouched.

With a view of furthering these efforts and translating our experience in Europe into the most effective service to our own American children, the important personnel of the American Relief Administration have joined in a consolidation of the American Child Hygiene Association and the Child Health Organization of America, in the formulation of a new, stronger, voluntary agency for the advancement of these questions. The American Relief Administration can give no more complete indorsement and expression of its confidence in the national necessity for such action. The name of the new organization is the American Child Health Association.

The American Relief Administration has undertaken as a voluntary service to guide the executive effort of the new organization in its endeavor to provide the essential finances necessary to carry on this most important work. I am therefore taking the liberty of appealing to you who have supported our past efforts, for support in this new activity of the American Relief Administration. The matter is one of national importance and of urgent character. I trust you may find it possible to contribute to the American Relief Administration for this purpose. HERBERT HOOVER.

Denaturing Rule Revised

An error in the regulations of 1915 covering the amount of caustic soda sufficient to denature 100 gal. of olive oil has been corrected by the Treasury to provide for the use of 114 lb. of caustic soda instead of 15 lb.

Fire Does Not Stop Work

Mines Bureau at Cornell Carries On Investigation Despite Loss of a Building

Fire recently destroyed one of the Cornell laboratories of the Bureau of Mines. The loss, however, is not such as to interfere seriously with the interesting work on alloy steels being carried on there.

The tests being made deal chiefly with endurance under repeated bending of various steels containing the rarer elements. Especial attention is being given to molybdenum as an alloying element.

About fifty steels, each with various heat-treatments, ranging in composition through plain C, Ce, Mo, V and CrCrMo, CrCe, CrV, NiCr, to various NiCrMo, NiCrCe and NiCrV steels are being studied. The ordinary tensile, impact and repeated impact tests have been made and a good deal of endurance data has been collected. Over 1,000 endurance test bars will be required, and nearly all of these are ready for testing. Two endurance machines are running night and day, and it will take all the present fiscal year and probably more to obtain the data desired.

While the work is aimed primarily to show the effect of Mo on endurance in comparison with other alloying elements, it is planned also with the view of getting as much information as possible on the general problems of endurance and endurance testing.

Flotation Process Case Heard by Commission

Three firms in the minerals separation industry are charged with unfair trade practices. To determine whether or not Minerals Separation, Ltd., Minerals Separations North American Corporation, Ltd., and Beer, Sondheimer & Co. have established a monopoly in connection with the leasing to American mining interests patents for the separation of minerals by the flotation process, the Federal Trade Commission heard final arguments recently on its complaint against these concerns.

In prosecution of the case the counsel for the commission charged that the respondents have set up a monopoly in the United States, compelling operators to surrender improvements, charging excessive royalties, and that they have been guilty of other unfair practices.

In defense, counsel for the respondents asserted that the services rendered the American mining industry have been of vast value in reclaiming ores.

Seeking More Import Data

To have immediately available detailed information as to dye imports has proved of such value that an insistent demand has arisen in the chemical industry for the expansion of that service to all of the coal-tar products. In various quarters hope is expressed that eventually the service may be extended to all synthetic organic chemicals.

Alabama to Produce Arsenic

Large quantities of calcium arsenate are to be manufactured at Anniston, Ala., this spring. The plant of the Federal Phosphorus Co. has recently added machinery for the extraction of the arsenic from arsenical pyrites ore.

Chemists in the vicinity of Anniston are making other experiments with different poisons for the extermination of the boll weevil. Although the results of their work indicate the possible development of a better poison than calcium arsenate, no definite information regarding its composition has been made public. In the meantime the arsenate industry at Anniston is expected to grow because of its availability of pyrites in almost unlimited quantities in close proximity to the plant.

Chemical Warfare Program of Secretary Davis

Country Divided Into Four Districts—Emergency Output of Industries Planned

The recommendations of J. M. Wainwright, retiring Assistant Secretary of War, as outlined in last week's *Chem. & Met.*, form the basis of a definite program of the War Department. Peace-time planning for the handling of industries during war has progressed further than ever before. Assistant Secretary Davis, who succeeds Colonel Wainwright, announces that he will carry forward this program actively.

Progress Already Made

Just what has been done in the way of chemical preparedness is indicated by extracts from the following C.W.S. report:

The country has been divided into four districts. The first district, which includes the New England States, will have its headquarters in Boston; the second district, which includes New York, New Jersey and Delaware, will have headquarters in New York City; the third district, with headquarters at Pittsburgh, will include Ohio, Pennsylvania and all states south of these two and east of the Mississippi and Ohio Rivers; the fourth, with headquarters in Chicago, will include all other states, those lying west of the Mississippi and Ohio Rivers and the state of Ohio. Each district will be assigned a chief, who will be a reserve officer. Each chief will have two assistants, both to be reserve officers and, if practicable, one to be a chemical engineer and the other a mechanical engineer.

In addition to this military organization, which will have direct charge of procurement planning, there are to be appointed civilian advisers to assist the officers in securing information and work out the details of the planning. There are to be eight such advisers for each district, one on manufacturing chemicals and one each for fine chemicals, rubber, charcoal, die castings, sheet metal stampings, war gases and chemical engineering equipment. Each of these men is to be an expert in the particular line assigned to him.

Present Procurement Plans

The work on procurement planning for the coming year is based on the war plans which have just been completed. These plans are the first attempt to work out in detail the quantities of each and every item which the Chemical Warfare Service would be required to furnish in case of war. With these requirements as a basis there has also been worked out the sources of supply of both raw materials and finished products necessary to meet the requirements. This information, on sources of supply, has been obtained in part from statistical tables prepared by various government bureaus and in part by dealing directly with the various industrial organizations concerned. In all, about eighty plants have been visited and estimates of their present production and possibilities for expansion have been obtained.

Allotment of War-Time Production

To these and other manufacturers have been allotted definite quantities of the various items which they will be expected to deliver in case of war. It is probable that some of these allotments cannot be filled, and in other cases manufacturers will be able to do much more than meet their allotments.

The Chemical Warfare Service will furnish each district chief with a list of manufacturers in his district allocated to the Chemical Warfare Service and the quantities of the various items which we have estimated each manufacturer can deliver. With this information as a basis, any errors in the estimates are to be corrected, in part by conference with the advisers in the districts and also by dealing directly with the manufacturer concerned.

U. S. Timber Going Fast

Reforestation Stated to Be the Only Hope of Future Pulp Supply by Secretary Wallace

That only one-third of America's timber supply remains is the finding of the special Senate committee appointed to look into wood and pulp problems. This committee is endeavoring to devise a workable plan for reforestation to submit to Congress. H. P. Baker, executive secretary of the A.P.P.A., and Secretary Wallace have given the committee figures showing the significance of the present situation.

Of our original supply of approximately 5.2 trillion board feet not over 1.6 trillion remains. Secretary Wallace estimates a possible reforestation of from 25 to 30 million feet per year.

Views of Mr. Baker

Mr. Baker, speaking for the pulp and paper manufacturers, gave it as his opinion that many "lean years," due to the depletion of the raw materials, were ahead of the industry in this country. The problem of the forests, he added, was entering the economical stage, and in the future the spruces and other pulp woods would bring such increased prices as to make forest conservation a paying business.

Another problem now being worked upon, as pointed out by Mr. Baker, is the utilization of Southern pine for pulp. He believes the South is to be the home of a great paper industry once a method is discovered for removing the resin from pine timber.

Canadian Paper and Pulp Exports Show Increase

A special report just issued by the Canadian Pulp and Paper Association shows that the total value of pulp and paper exports for January was $10,298,243, being an increase of $1,466,763 over January, 1922. Of this amount pulp and paper to the value of $9,286,186 went to the United States. Exports of pulpwood for January were 133,328 cords, valued at $1,195,886, compared with 66,094 cords, of the value of $696,943, in January, 1922.

Figures for the first 10 months of the fiscal year show newsprint exports were nearly 50 per cent greater than in the same period of the previous year.

German Dye Trade Faces No Immediate Shortage

Sufficient stocks to meet market demands for at least 6 months are on hand, according to Dr. Carl Duisberg, director of the Leverkusen Dye Works. In discussing the condition existing in the dye industry he said in part:

"The chemical industry also has taken part in the price reduction movement and has cut the prices of a number of its products, especially such as exceeded the world market prices.

"The situation in the chemical industry at present is completely different in the various districts. As is known, Ludwigshafen already lies idle, and the other works have no great supplies of fuel. For the present they will not get new coal in sufficient quantities, since they refuse to pay the taxes demanded by the French. The workmen will continue to be employed at other labors in case production is brought to a standstill.

"The Badische Soda und Anilin Fabrik faces this condition, as well as the Oppau works. Hoechst already is working with heavy curtailments. In Elberfeld, the parental plant of the Leverkusen works, the circumstances are even more difficult.

"The works in Leverkusen itself, which lies in part in the English zone, are not so severely stricken by the Ruhr war, and favorable conditions still prevail. They have chiefly lignite coal obtained in the English zone itself."

After his assertion that the dye industry is well supplied with stocks, Dr. Duisberg says that, in case of necessity, one source of supply could help another out and that, "during the French boycott on exports," the workmen will be engaged in handling the stocks on hand and keeping the plants in operating order.

Chemistry Chief to Be Selected

Congress having failed to act on the proposal to increase salaries for chiefs of bureaus and scientific investigators in the Department of Agriculture, it has been determined to fill the vacancy in the office of chief of the Bureau of Chemistry at the earliest possible time. The place has been held open in the hope that a salary higher than $5,000 could be offered to those best qualified to fill the position.

Dr. E. D. Ball, director of scientific work for the department, will appoint a consulting committee on which he hopes to induce some of the outstanding men in the chemical industry to serve. With this committee he will discuss not only the filling of the vacancy but the whole program of future work for the Bureau of Chemistry.

Constants Meeting Held

The board of editors of the International Table of Physical and Chemical Constants held a meeting at the National Research Council in Washington on March 23.

Would Give Prize for Oil Disposal Method

Interesting Bill Introduced Into New York Legislature for Solution of Knotty Problem

Considerable agitation has recently arisen for finding a solution to the vexing problem of what to do with the oil refuse dumped into New York harbor and the waters adjacent thereto. The State Senate not long ago passed a resolution memorializing Congress to adopt appropriate legislation to prohibit such practice.

In order to combat the nuisance a cheap economical method of disposal of this waste must be obtained. That inducement for research along this line may be offered a bill has been introduced into the New York State Legislature offering awards or prizes of $20,000 for the solution of the problem.

Annual Convention Business and Technical Librarians

The Special Libraries' Association, which is a national organization of all business and special librarians in the country, will hold its fourteenth annual convention in Atlantic City, Tuesday, May 22, to Friday, May 25, at the Hotel Chelsea. On Monday evening, May 21, the New York Special Libraries' Association will hold its last monthly meeting of the year, to which all delegates to the convention are invited. On Tuesday all the special libraries of New York City will be open to visitors. Saturday, May 26, following the convention at Atlantic City, the Special Libraries' Council of Philadelphia and the District of Columbia Library Association will have local meetings to which all the librarians are cordially invited, and an opportunity is thereby given to visit the special libraries in these two cities.

All librarians, special and public, are cordially invited. Business men and research workers and statisticians are also urged to meet at the Special Libraries' Association Convention.

Norway to Hold Industries Fair

Norway is to have an industries fair this year. This is in keeping with the custom inaugurated in 1920, which has been followed in successive years and which each year has proved to be a great success. Keen interest both in the home country and abroad has been aroused in these fairs. The number of entries last year was very large. Practically every branch of Norwegian industry and handicraft was represented and exhibits were sent in from every manufacturing center throughout the country.

This year the fair is to be held the week of Sept. 2 to 9. It is planned to give foreign buyers a good opportunity of acquainting themselves with Norwegian products and manufactures of every description and of getting into closer personal contact with firms in various lines of trade.

Illinois Alumni to Gather at New Haven

Chemists from the University of Illinois are not to be outdone by the alumni of Harvard, Ohio State and other institutions who in the past have held their luncheon reunions in connection with the semi-annual meetings of the American Chemical Society. On April 5 at 1 p.m. in Woolsey Hall at Yale University the Illinois alumni will gather for the first of their reunions. Dr. C. S. Palmer, Box 1811, Yale station, New Haven, Conn., is in charge of the preparations for this event.

City Air Pollution by Auto Exhaust Is Menace

Chemical engineering may be required to solve the problem of handling the carbon monoxide in city streets. Automobiles in New York City are giving off so much of this gas that it has become a menace to health, according to the public health committee of the New York Academy of Medicine.

According to a report issued by this body:

"The increasing concentration of motor traffic in New York City has resulted in contamination of the air with carbon monoxide in certain sections of the city which has reached the point where it is regarded as deleterious to health. Carbon monoxide constitutes from 7 to 12 per cent of the exhaust gas, depending upon the mixture of the gasoline. It oxidizes very slowly, if at all, and the rate of rapidity of its diffusion in the streets varies with atmospheric conditions and the velocity of the winds.

"The studies of J. S. Haldane in London have led to the formulation of a safety standard in the London underground railways of not more than one part of carbon monoxide in 10,000 parts of air. The standard adopted for the New York-New Jersey vehicular tunnel is a maximum of four parts of carbon monoxide to 10,000 parts of air, provided no one is exposed for more than thirty or forty minutes.

"The committee engaged the services of Prof. Yandell Henderson to study the extent of contamination of the air in New York City streets. This study has not been completed, but the preliminary indications are that at certain periods of the day and in certain areas of the city the concentration of carbon monoxide is such as to require remedial measures."

Mines Bureau Loses Building

The building of metallurgy at the Michigan College of Mines, Houghton, Mich., was destroyed by fire, March 15, with loss estimated between $250,000 and $275,000. Valuable records were lost in the disaster, including those of the United States Bureau of Mines, occupying offices in the building. It is said that the structure will be rebuilt as soon as plans are prepared and arrangements perfected.

Chemical Production Figures Coming Soon

Many replies to the Tariff Commission's questionnaire are being received from domestic producers. Present indications show that the annual census of production of coal-tar and synthetic organic chemicals and dyes for 1922 will be issued this year considerably earlier than previously.

Last year, for the 1921 census, there were 201 producers of coal-tar chemicals, some of whom also produced synthetic organic chemicals from other than a coal-tar base, and there were about forty manufacturers who produced the latter only. There is a slight reduction in the number of manufacturers this year, several small plants having gone out of business. Up to March 21, replies had been received by the commission from 189 manufacturers. If reports for 1922 production continue to be received with satisfactory speed, there will be no preliminary report this year, but the final report will be ready some time in May.

Develops Leaching System

Dr. J. W. Turrentine, formerly in charge of the experimental kelp-potash plant of the Bureau of Soils at Summerland, Calif., has developed a lixiviating system for industrial use, involving some new principles of counter-current leaching, for which a public patent is being sought. This process and apparatus was given a thorough try-out and demonstration in the extraction of potash and iodine from kelp. It is applicable to several industrial processes where continuous and economic leaching is desired.

To Dismantle Chlorine Plant

Officers of the Chemical Warfare Service announce that a portion of the chlorine plant at Edgewood Arsenal must be dismantled. Plans are being made at present to engage a competent chemical engineer to direct this work so that the equipment can be taken down and stored with the certainty of subsequent reassembly when the need arises without technical difficulty or damage to the equipment. It is hoped that this work can begin at an early date, but the time is contingent upon finding a proper chemical engineer to direct the job.

Obituary

LEWIS E. RANSOM, of Hempstead and New York, and president and founder of the L. E. Ransom Co., importer of dyestuffs, died recently.

WALL EDWARD SMOTHERS passed away in Denver, Jan. 31, 1923. Although but 29 years of age, he had attained unusual prominence in his chosen profession, that of radium technology. Upon his graduation from the University of Colorado in 1916 as a bachelor of science, he entered the employ of the Schlesinger Radium Co. of Denver. For some time he was occupied with radium measurements by both emanation and gamma-ray methods, with considerable analytical work connected with proposed processes for the treatment of carnotite. Later he was placed in charge of the refining and crystallizing of the radium product and its distribution into the many types of therapeutic applicators. He conducted many courses of instruction in the physics and therapy of radium for physicians and surgeons. Tireless energy and painstaking care were characteristic of all his work. His untimely death is a great loss to the science of radio-activity. He was married to Elizabeth L. Hoskin, of Denver, June 15, 1917. He was a member of Alpha Tau Omega and the national chemical fraternity, Alpha Chi Sigma.

Personal

WILLIAM B. BOYD has been elected president of the Dominion Alloy Steel Co., Ltd. Mr. Boyd was formerly electrical engineer of the Illinois Steel Co., Chicago; chief electrical engineer of the Dominion Iron & Steel Co., Sidney, N. S., and chief engineer of many large Canadian industries.

CHARLES T. BRAGG, formerly chief metallurgist of the Michigan Smelting & Refining Co. and more recently president of the Michigan Valve & Foundry Co., has resigned from the latter position.

W. J. COPE, Akron, Ohio, has been elected treasurer of the Mohawk Rubber Co., to succeed C. W. MCLAUGHLIN, resigned. Mr. Cope has been assistant treasurer for a number of years.

Prof. T. E. DONNAN, of the University College of London, has accepted an invitation to attend the New Haven meeting of the American Chemical Society.

R. E. DOOLITTLE of Chicago, chief of the central food and drug inspection district of the Bureau of Chemistry, attended a meeting of the joint committee on definitions and standards in Washington during the week of March 19.

WILLIAM HAYNES has accepted the chairmanship of the chemical division in the forthcoming Home Service Appeal of the Salvation Army for a $500,000 fund with which to maintain and extend its activities in Greater New York.

Dr. KUNO B. HEBERLEIN has left for Europe on business.

O. P. HOOD, chief engineer of the U. S. Bureau of Mines, spoke March 23, at Akron, Ohio, on "Smoke Abatement and Smokeless Combustion."

G. F. MOULTON has resigned his position at the Bureau of Standards to accept a place as chemist of the research department of F. C. Huyck & Sons, Albany, N. Y.

Dr. WALTER ROSENHAIN, chief of the metallurgical department of the National Physical Laboratory, Teddington, England, addressed the members of the Detroit, Mich., chapter of the American Society for Steel Treating at its regular monthly meeting March 19, on "Strain and Fracture in Metals." He also spoke recently before a joint meeting of the scientific and technical societies of Schenectady, under the direction of the Eastern New York Section of the American Chemical Society, on "The Relation Between the Properties and Structure of Metals." Dr. Rosenhain expects to reach Washington, D. C., March 30 for a 5-day visit. On the afternoon of that date he is scheduled to speak at the Bureau of Standards. On the following day he will be tendered a banquet at the Cosmos Club which will be under the auspices of the Washington Academy of Sciences. Following the dinner he will speak on "The Structure and Constitution of Alloys." He expects to spend April 2 and 3 exclusively at the Bureau of Standards, where he hopes to gather a detailed idea of the manner in which that bureau is conducting its research.

JEROME STRAUSS, chief chemist of the U. S. Naval Gun Factory, Washington, D. C., addressed the Washington chapter of the American Society for Steel Treating on March 16. His topic was "Performance of High-Speed Cutting Tools."

LEONARD SUMNER was elected president of the British Institute of Metals at the annual general meeting on March 7.

Sir J. J. THOMPSON, of Cambridge University, is to give a series of lectures at Franklin Institute during the week of April 9.

Dr. F. C. WEBER, chemist in charge of the Animal Physiological Laboratory, Bureau of Chemistry, has resigned to accept a position with the Fleischmann Laboratories, New York. Dr. Weber entered the Bureau of Chemistry as a scientific aid in 1902 and after receiving an M.D. degree from George Washington University assisted in experimental work to determine the effect of preservatives on health. He was placed in charge of the Animal Physiological Laboratory in 1907 and directed the work of that laboratory until his resignation, except for a short period of detail to the Tariff Commission.

W. R. M. WHARTON of New York, chief of the Eastern food and drug inspection district of the Bureau of Chemistry, was in Washington recently conferring with officials of the bureau regarding regulatory campaigns.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities Prevailing Prices and Market Letters From Principal Industrial Centers

Better Business Conditions Are the Result of Increased Productive Activity

Expansion in Output of Basic Industries a More Substantial Basis for Prosperity Than Increasing Credits or Rising Prices

IT IS especially significant in the view of many of our leading economists that the prosperity being enjoyed by many of our industries is based on expanding production rather than expanding credit—the principal cause of the inflation of 1919 and 1920. The production figures obtained by the Department of Commerce indicate record industrial activity during the first two months of the current year.

One of the industries reflecting this stimulation to marked extent is the manufacture of textiles—important as a basic industry and a large consumer of chemicals and allied products. The daily rate of cotton production was even higher than the January high record and silk consumption was the highest with one exception since 1919. Wool receipts at Boston were the highest since April, 1921, except for July, 1922. Stocks of cotton at mills were the lowest reported for this season of the year since 1914.

The construction industry, a market for oils and paints, steel, glass and other products, also made new records. The volume of building contracts awarded in February, contrary to an expected seasonal decline, increased in twenty-

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	181.44
Last week	179.51
March, 1922	156.00
March, 1921	157.00
March, 1920	252.00
April, 1918 (high)	286.00
April, 1921 (low)	140.00

The effect of the many price advances and the continued strength of the chemical market is reflected in this week's index number. Potassium carbonate and hydroxide and linseed and cottonseed oils were the index commodities to show advances.

TABLE I—PRODUCTION AND PRICES OF CHEMICALS, 1913-1922

(Compiled by the *Survey of Current Business* from government and non-government sources.)

(Base year in bold-faced type.)

Year and Month	Production[1] Acetate of Lime	Production[1] Methanol	Consumption[1] Wood, Carbonized	Stocks[1] Wood	Wholesale Prices: Drugs and Pharmaceuticals[2]	Wholesale Prices: Essential Oils[2]	Wholesale Prices: Crude Drugs[2]	Wholesale Prices: Chemicals[4]	Wholesale Prices: Sulphuric Acid 66° New York[5]	Production[1] Acetate of Lime	Production[1] Methanol	Consumption[1] Wood, Carbonized	Stocks[1] Wood	Wholesale Price Sulphuric Acid 66° New York[5]
	Relative to 1920				Relative to August, 1914			Relative to 1913		A.—INDEX NUMBERS				
										Thousands of Pounds	Gallons	Cords		Dollars Per 100 Lb.
										B.—NUMERICAL DATA				
1913 mo. av.								**100**	**100**					**1.00**
1914 mo. av.					**100**	**100**	**100**		100					1.00
1915 mo. av.									129					1.30
1916 mo. av.									200					2.00
1917 mo. av.								212	169					1.70
1918 mo. av.								279	163					1.60
1919 mo. av.									95					1.00
1920 mo. av.	**100**	**100**	**100**	**100**	196	265	202	255	112	**12,150**	**635,438**	**76,028**	**846,204**	1.12
1921 mo. av.	39	46	42	84	129	158	134	153	91	4,704	291,697	32,064	714,302	.91
1922 mo. av.	81	87	81	108	120	137	174	155	76	9,833	550,594	61,371	911,211	.80
1921														
January	51	71	70	79	155	200	153	181	92	6,243	448,831	53,192	669,010	.92
February	49	64	59	74	149	189	145	166	98	5,971	407,363	44,527	622,041	.98
March	44	64	57	70	141	178	141	157	100	5,381	407,143	43,640	676,765	1.00
April	26	37	34	84	135	168	138	140	95	3,162	234,835	26,191	709,043	.95
May	28	33	31	90	129	165	136	143	90	3,355	211,078	23,483	762,013	.90
June	29	31	28	88	126	159	135	147	90	3,474	198,675	21,641	742,857	.90
July	21	25	22	83	125	151	130	148	90	2,603	160,724	16,827	702,445	.90
August	24	24	23	82	123	142	126	158	90	2,937	155,020	17,744	697,566	.90
September	29	31	29	81	119	138	123	147	90	3,552	197,230	21,670	688,899	.90
October	39	41	37	85	117	138	126	151	85	4,785	258,599	28,491	721,696	.85
November	54	57	51	84	116	135	127	147	85	6,517	362,317	38,982	714,027	.85
December	70	72	64	102	118	137	132	145	85	8,465	458,553	48,382	865,258	.85
1922														
January	69	74	65	103	117	136	134	144	80	8,330	468,818	49,559	875,010	.80
February	66	72	65	111	115	136	139	148	80	7,993	457,656	49,465	936,859	.80
March	80	84	76	105	116	135	155	156	80	9,660	534,812	57,874	899,781	.80
April	61	65	58	106	117	135	177	158	84	7,390	416,112	43,775	895,826	.84
May	58	64	59	105	116	135	177	159	80	7,064	404,847	44,496	889,219	.80
June	62	69	66	107	115	133	177	157	80	7,495	441,149	50,207	904,909	.80
July	72	75	74	112	115	130	178	156	71	8,718	475,376	56,570	943,792	.70
August	76	80	77	104	115	135	177	152	70	9,253	508,644	58,887	881,858	.70
September	78	85	78	111	121	131	182	149	74	9,537	537,803	59,486	937,748	.70
October	101	105	98	113	128	122	195	154	73	12,217	664,933	74,582	956,425	.70
November	122	125	121	110	131	121	196	160	70	14,779	795,569	91,944	928,499	.70
December	133	142	131	105	137	123	204	164	70	16,154	901,403	99,605	884,609	.70

[1] Compiled from reports of the National Wood Chemical Association to which are added reports from the principal non-member firms. Total reports for each month vary from firms with a capacity of 3,200 cords to 4,500 cords daily; all months are therefore prorated to a daily capacity of 4,500 cords, representing about 90 per cent of the industry, on the basis of capacity reporting each month.

[2] August, 1914.

[3] Compiled from weekly wholesale quotations by the *Oil, Paint and Drug Reporter*.

[4] The chemical price index from *Chemical & Metallurgical Engineering* includes quotations on 25 commodities selected on the basis of their importance as representing both qualitatively and quantitatively the principal branches of the chemical industry. These prices are weighted on the basis of total production plus total imports in the year 1919. The figures are averages of weekly prices.

[5] Wholesale average monthly price of sulphuric acid from United States Department of Labor, Bureau of Labor Statistics.

seven northeastern States to 41,611,000 sq.ft. All classes of buildings except residential and public buildings participated in this increase, which has continued into March. The week of March 10 showed the highest total of building awards of any week since July, amounting to $78,411,000.

Trend of Chemical Production

In Table I are given the Commerce Department's figures for the production and prices of those chemicals and groups of products which are included in the monthly compilations of the *Survey of Current Business*. Statistics for 1923 are not given in this tabulation, but in a statement made on March 23 the department declared that the production of acetate of lime and of methanol declined slightly in January from the high mark set in December. Acetate of lime output amounted to 16,544,000 lb., as against 16,814,000 lb. in December, and methanol production was 933,171 gal., as against 942,008 gal. in December. Consumption of wood, however, increased to 104,180 cords, while stocks of wood at chemical plants declined to 833,767 cords, the lowest since November, 1921.

Wholesale Prices Rise in February

A slight rise in the general level of wholesale prices in February as compared with January is shown by the Bureau of Labor Statistics in its weighted index numbers. The all commodity index, based on 404 price series, stands at 157 for February, or one point higher than in January.

The principal increases were in the case of metals and metal products, although the chemicals, building materials and miscellaneous groups recorded advances. The bureau's index numbers for May, 1920, which was practically the month of peak prices, are compared with the more recent figures in the accompanying table.

Group	May 1920	Jan. 1922	Nov. 1922	Dec. 1922	Jan. 1923	Feb. 1923
Farm products	241	122	143	145	143	142
Food, etc.	248	131	143	144	141	141
Cloths and clothing	328	176	192	194	196	199
Fuel and lighting	239	195	218	216	218	212
Metals and metal products	202	112	133	131	133	139
Building materials	293	157	185	185	188	192
Chemicals and drugs	213	124	127	130	131	132
House furnishing goods	247	178	179	182	184	184
Miscellaneous	208	117	122	122	124	126
All commodities	247	138	156	156	156	157

Comparing prices in February with those of a year ago, the report of the Bureau of Labor Statistics points out that the general level has risen over 11 per cent. Metals and metal products show the largest increase, 26¼ per cent. Building materials follow next with an increase of 23 per cent. Cloths and clothing have increased 14¼ per cent, fuel and lighting 11 per cent, and farm products 8¼ per cent in price in the year. Food articles, chemicals and drugs, housefurnishing goods and miscellaneous commodities all show smaller increases compared with prices of a year ago.

Higher Quotations on Potash Salts Feature New York Market

Potassium Permanganate, Carbonate and Bichromate Figure in General Advance Said to Be Due to Importing Difficulties

NEW YORK, March 26, 1923.

MATERIAL improvement was noted in the chemical market during the past week in the case of many imported commodities. Importers reported higher cables from abroad on all potassium salts and stated that round-lot shipments were quite difficult to locate. The feature of the week's activities was the sharp advance in permanganate of potash. Dealers were not anxious to quote large quantities, due to the extremely high foreign quotations and the strong domestic demand. Importers of carbonate of potash advanced quotations on 80-85 per cent calcined material. Dealers in arsenic also announced an advance.

Costs Are Mounting

Manufacturers of amyl acetate reported higher quotations on account of increased production costs and heavier demand. Resale oxalic acid was not as plentiful, as previously noted, and spot goods were sharply advanced. Producers and importers announced higher prices on powdered and crystal tartaric acid. Manufacturers of bichromate of potash raised their prices, due to the strong domestic and foreign demand. Resale supplies have been gradually absorbed. Second hands in formaldehyde were anxious to book business at concessions and the general range was fractionally lower. The alkali market continued with prices practically unchanged. The demand was said to be quite satisfactory to the leading producers. Manufacturers of salicylic acid announced advances on the technical and U.S.P. varieties. The market in general has already begun to show the long-contemplated spring activity and those close to the pulse of trading were firm in their belief that the beginning of a general swing toward increased trading has already shown itself.

Many Price Advances

Amyl Acetate — Leading producers announced a sharp advance, due to the increased cost of production and strong domestic inquiry. Prices range around $3.25@$3.50 per gal.

Arsenic—Dealers were inclined to advance prices to 15½c. per lb. on spot and 15c. for future arrivals. Consumers have shown some desire to purchase at the new levels.

Bichromate of Potash—Large producers announced an advance, due to increased export demand. Prices range around 10¾@11c. per lb. for immediate shipment.

Bleaching Powder — Activity was along former lines, with producers quoting $2.20 per 100 lb., f.o.b. works, large drums. Spot material was rather scarce at $2.50 per 100 lb.

Carbonate of Potash — Leading importers reported an advance on 80-85 per cent calcined, due to the difficulty in obtaining any round-lot shipments from abroad. Consuming demand has shown material increase and dealers were not inclined to offer any spot goods below 6c. per lb. The range was around 6@6½c. per lb.

Caustic Soda—Export inquiries continued along moderate lines, with leading dealers quoting $3.45@$3.50 per 100 lb., f.a.s. Domestic goods held around 3¾c. per lb. ex-store. Contracts were quotably unchanged.

Formaldehyde — Resellers were inclined to shade prices on actual business. Quotations ranged around 14½@15c. per lb. on spot. Producers quoted 16c. per lb. for carload lots and 16½c. for lesser quantities.

Permanganate of Potash — Importers reported a sharp increase in foreign cables, due to the present unstable conditions in Germany. Quotations on spot were sharply advanced by local dealers and the general range was 25@26c. per lb. for limited quantities. Shipments were quoted at 18c. per lb., duty unpaid.

Salicylic Acid — Manufacturers announced increases in technical and U.S.P. goods. Quotations for U.S.P. range around 50@52c. per lb., with technical at 47@48c. per lb. Demand continued along moderate lines.

Naphthalene—A very active market exists for this article, with quotations on all grades sharply higher. Naphthalene balls were quoted at 10@10½c. per lb., with flakes at 9@9½c. per lb. on spot. Futures were quoted around 8¾c. per lb. Crushed material was difficult to locate for any shipment.

Phenol—Demand continued quite active at 50c. per lb. on spot. Trading was mostly for small quantities.

Vegetable Oils

Linseed Oil—Leading crushers announced several advances during the past week. Prices changed from $1.01 per gal. to $1.03 and another advance brought quotations up to $1.05 per gal. on spot. Demand has been quite active at the present high levels.

Cottonseed Oil—Crude oil advanced early in the week to 11c. per lb. in tanks, but receded later to 10¾c. per lb. f.o.b. mills, southeast and valley. The demand has not been unusually strong due to the high prices. Prime summer yellow was quite active around 12¾@13c. per lb. in barrels.

China Wood Oil—Prices have again been advanced on spot. Quotations range around 25@26c. per lb. in barrels.

Price Advances Rule in St. Louis Market

Indications Point to Firmer Market for Some Time to Come

ST. LOUIS, MO., March 22, 1923.

Price advances on some of the important chemicals during the past few weeks have stimulated buying, and the volume of business tranacted in the St. Louis market has been very satisfactory. Prices today are firm, and indications are for an advancing market for some time to come. Imported materials are much higher today than for some time past, and in view of conditions abroad further advances would not be surprising.

Firm Alkali Market

The market for alkalis continues firm and a good volume of business is being transacted. However, the last 2 weeks have not been as good as the months of January and February. *Caustic soda* is maintaining the regular schedule, though a slight decline in volume is reported. Flake caustic in 5- and 10-drum lots is generally quoted at $4.25 per 100 lb. and one producer is holding the price at $4.30. Solid caustic in like quantities is offered around $4.85@$4.90 per 100 lb. These prices are delivered buyer's door. *Soda ash* 58 per cent light can be had in round lots at $2.25 in barrels and $2.10 in bags. These quotations are on a 5- or 10-package basis and are usually shaded from 5 to 10c. per 100 lb. when bought in truckloads. *Bicarbonate of soda* is maintaining its strength, the recent advance in price apparently not affecting the volume of business. *Sal soda* has shown some life recently and better business on this item is expected.

General and Special Chemicals

Heavy mineral acids, particularly *muriatic*, are moving in large volume. It is reported that the production has been increased, but manufacturers have little to dispose of above their contract requirements, and supplies have become very tight. The movement of *sulphuric* and *nitric* has also been very good. Inquiry for *citric acid* has been somewhat better; however, trading is not so good. Importations have been very light and stocks are also low of both the foreign and domestic article. The *cresylic acid* market is almost bare of stocks. The output of domestic producers is very small and has been sold up for some months to come, and with the present cost of importing foreign goods there is no relief looked for in the immediate future. *Oxalic acid* has shown no unusual activity and trading is being done only through regular channels. *Tartaric acid* has been showing more life and some fairly large sales are being made. Trading in *white arsenic* has quieted down as far as spot goods are concerned, and consumers apparently have sufficient supplies for their immediate need. *Cream of tartar* is in better demand. The demand for *copperas* has been very good and supplies have been absorbed as quickly as they became available. Quotations are firm, with the sugar grade quoted at $1.13 per 100 lb. in bulk in carload lots f.o.b. St. Louis, and $1.38 per 100 lb. in barrels in carload lots f.o.b. St. Louis. *Glycerine* continues to hold its own very well at 18¼c. in drums. As previously reported, this is a buyers' market and the price is not expected to decline in the face of a lively demand. In fact a higher level on this commodity is not beyond the bounds of possibility. The *phenol* market is exceedingly strong and supplies continue to be very scarce. Large quantities are not available and only occasional small lots are heard of. *Potassium bichromate* is moving in a fair way. The demand for *cyanide of potash* is normal. *Permanganate* prices are going up steadily, with spot stocks very small and held in firm hands.

The *zinc* market is advancing and *spelter* is now quoted at $8 per 100 lb. f.o.b. St. Louis and $8.35 per 100 lb. f.o.b. New York. *Zinc sulphate* has had no change since our last report and is still quoted at 3¼c. f.o.b. St. Louis in carload lots and 3¾c. f.o.b. St. Louis in less than carload lots, with a very good demand. *Zinc dust* is offered today at 11c. per lb. f.o.b. St. Louis, with a very good demand.

Rumors of Wage Advances Affect Steel Market

Prices Are Stiffening All Along the Line, Although Production Is Still High

PITTSBURGH, March 23, 1923.

Production of steel continues to run very heavy. The rate of ingot production at this time is probably well above 45,000,000 tons a year, which until recently was the record high since the armistice, reached in March, 1920, but by no means sustained.

The steel mills will make every effort to maintain their present high rate of production. Earlier in the year there were fears that the labor shortage of last October would reappear in greater strength in the spring, with resumption of outdoor work on a larger scale. While labor shortage would of course tend to restrict the consumption of steel, the production of steel would hardly escape feeling an influence. In this connection there are now two points. It is the prevalent expectation among independent steel producers that the Steel Corporation, which always leads in such matters, will announce a general wage advance shortly, probably to be effective April 1. There is absolutely no confirmation of this view from any Steel Corporation source, but such announcements are not unusually preceded by unofficial information leaking out. In some steel circles prognostication goes farther, to the effect that such a wage advance might be followed by another in midsummer. Undoubtedly there will be strenuous bidding for labor on the part of many contractors, but wage advances would help to retain men. Another point is this, that a steel mill once operating smoothly and with large tonnage output does not need as large a force to maintain operations as it did to get going, and the steel industry has now got the start.

Steel Prices Stiffening

At various points the steel market is growing stronger in the matter of prices. Recently bars, shapes and plates reached 2.25c. as a basis market for late or extended delivery, while premiums have been ruling on small lots for early shipment. On shapes and plates the minimum for any delivery may now be considered 2.35c., or $2 a ton advance. Premiums are greater. Plates do not stop at 2.60c., but command 2.75c. frequently and perhaps 3c. in some cases. One mill is quoting bars at 3c., and many obtain the price.

Sheets show a variegated market. Reports to the association of independents, covering about 70 per cent of the productive capacity, show order books March 1 for the reporting mills representing about 2 months of work, but this is merely a composite. Some mills are fairly well sold up through the second quarter at what may be denominated conservative prices, say 3.60c. on common black, while other mills have correspondingly less business ahead. These mills, able to offer relatively early deliveries, are out for premiums. Some are quoting as high as 4c. on black, 5.25c. on galvanized and 7c. on automobile sheets, and are presumably effecting sales. A wire mill has put out a price of $3 a keg on nails, although stating it is fully sold up, while the common market, for late delivery, is nearer $2.80.

Pig Iron and Coke

One additional second quarter contract in Connellsville furnace coke has been made since last report, for 10,000 tons a month, at $7.50 or perhaps a trifle more. The total in the movement a week ago was about 300,000 tons a month, chiefly at $7, with perhaps a fourth of the total at $7.25. Export demand has lately been a factor in the coke market, between 75,000 and 100,000 tons having already gone, chiefly from the Connellsville region, at an average of not much under $7.50.

Valley pig iron has advanced a straight dollar a ton in the week, bessemer, basic and foundry being now quotable at $31 valley on the basis of latest sales, while $32 is predicted as a probability within a week. It is to be noted, however, that the bulk of the second quarter business was done before prices advanced above about $28. There is now a delicate balance between uncovered consumption and unsold production for the second quarter. Furnaces would like to push the market to $32, or perhaps $33, but not higher, the chief end to be gained being to have a ready made market when the time comes for third quarter business.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.36 – $0.38
Acetone, drums	lb.	.22 – .23
Acid, acetic, 28%, bbl. 100	lb.	3.15 – 3.40
Acetic, 56%, bbl. 100	lb.	6.25 – 6.50
Glacial, 99½%, carboys 100	lb.	12.00 – 12.50
Boric, crystals, bbl.	lb.	.11½– .11¾
Boric, powder, bbl.	lb.	.11 – .11½
Citric, kegs	lb.	.49 – .50
Formic, 85%	lb.	.15 – .17
Gallic, tech.	lb.	.45 – .50
Hydrochloric, 18° tanks, 100	lb.	.90 – 1.00
Hydrofluoric, 52%, carboys	lb.	.12 – .12½
Lactic, 44%, tech., light, bbl.	lb.	.11½– .12
22% tech., light, bbl.	lb.	.05½– .06
Muriatic, 20°, tanks, 100	lb.	1.00 – 1.10
Nitric, 36°, carboys	lb.	.04½– .05
Nitric, 42°, carboys	lb.	.06 – .06½
Oleum, 20%, tanks	ton	17.00 – 18.00
Oxalic, crystals, bbl.	lb.	.13½– .14
Phosphoric, 50% carboys	lb.	.08 – .09
Pyrogallic, resublimed	lb.	1.50 – 1.60
Sulphuric, 60°, tanks	ton	9.00 – 10.00
Sulphuric, 60°, drums	ton	12.00 – 14.00
Sulphuric, 66°, tanks	ton	14.50 – 15.00
Sulphuric, 66° drums	ton	19.00 – 20.00
Tannic, U.S.P., bbl.	lb.	.65 – .70
Tannic, tech., bbl.	lb.	.40 – .54
Tartaric, imp. crys., bbl.	lb.	.33 – .34
Tartaric, imp., powd., bbl.	lb.	.33 – .34
Tartaric, domestic, bbl.	lb.	– .33½
Tungstic, per lb.	lb.	1.00 – 1.20
Alcohol, butyl, drums, f.o.b. works	lb.	.27 – .29
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 – 4.95
Alcohol, methyl (see Methanol)		
Alcohol, denatured, 188 proof No. 1	gal.	.38 – .40
Alum, ammonia, lump, bbl.	lb.	.03½– .03¾
Potash, lump, bbl.	lb.	.03 – .03½
Chrome, lump, potash, bbl.	lb.	.05½– .05¾
Aluminum sulphate, com., bags 100	lb.	1.50 – 1.65
Iron free bags	lb.	.02½– .02¾
Aqua ammonia, 26°, drums	lb.	.06½– .07½
Ammonia, anhydrous, cyl.	lb.	.30 – .30½
Ammonium carbonate, powd. casks, imported	lb.	.09½– .10
Ammonium carbonate, powd. domestic, bbl.	lb.	.13 – .14
Ammonium nitrate, tech., casks	lb.	.10 – .11
Amyl acetate tech., drums	gal.	3.25 – 3.50
Arsenic, white, powd., bbl.	lb.	.15½– .16
Arsenic, red, powd., kegs	lb.	.12½– .13
Barium carbonate, bbl.	ton	78.00 – 80.00
Barium chloride, bbl.	ton	90.00 – 95.00
Barium dioxide, drums	lb.	.18 – .18½
Barium nitrate, casks		.08 – .08½
Barium sulphate, bbl.	lb.	.04 – .04½
Blanc fixe, dry, bbl.	lb.	.04 – .04½
Blanc fixe, pulp, bbl.	ton	45.00 – 55.00
Bleaching powder, f.o.b. wks., drums 100	lb.	2.20 – 2.50
Resale drums 100	lb.	2.50 – 2.75
Borax, bbl.	lb.	.05¼– .05½
Bromine, cases	lb.	.28 – .30
Calcium acetate, bags 100	lb.	3.50 – 3.60
Calcium carbide, drums	lb.	.04½– .04½
Calcium chloride, fused, drums	ton	22.00 –23.00
Gran. drums	lb.	.01½– .01¾
Calcium phosphate, mono, bbl.	lb.	.06½– .07
Camphor, cases	lb.	.91 – .93
Carbon bisulphide, drums	lb.	.07 – .07½
Carbon tetrachloride, drums	lb.	.09½– .10
Chalk, precip.—domestic, light, bbl.	lb.	.04½– .04½
Domestic, heavy, bbl.	lb.	.03½– .03½
Imported, light, bbl.	lb.	.04½– .05
Chlorine, liquid, cylinders	lb.	.06 – .06½
Chloroform, tech., drums	lb.	.35 – .38
Cobalt oxide, bbl.	lb.	2.10 – 2.25
Copperas, bulk, f.o.b. wks.	ton	16.50 – 20.00
Copper carbonate, bbl.	lb.	.19 – .20
Copper cyanide, drums	lb.	.47 – .50
Copper sulphate, crys., bbl., 100	lb.	6.40 – 6.50
Cream of tartar, bbl.	lb.	.24 – .25
Dextrine, corn, bags 100	lb.	3.25 – 3.50
Epsom salt, dom., tech., bbl. 100	lb.	2.00 – 2.25
Epsom salt, imp., tech., bags 100	lb.	1.10 – 1.25
Epsom salt, U.S.P., dom., bbl. 100	lb.	2.50 – 2.75
Ether, U.S.P., drums	lb.	.13 – .15
Ethyl acetate, com., 85%, drums	gal.	.80 – .85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 – 1.00
Formaldehyde, 40%, bbl.	lb.	$0.14½– $0.16½
Fullers earth, f.o.b. mines net	ton	16.00 – 17.00
Fullers earth—imp., powd., net	ton	30.00 – 32.00
Fusel oil, ref., drums	gal.	3.55 – 4.05
Fusel oil, crude, drums	gal.	2.30 – 2.40
Glaubers salt, wks., bags 100	lb.	1.20 – 1.40
Glaubers salt, imp., bags 100	lb.	1.00 – 1.25
Glycerine, c.p., drums extra	lb.	.18½– .19
Glycerine, dynamite, drums	lb.	.17 – .17½
Iodine, resublimed	lb.	4.55 – 4.65
Iron oxide, red, casks	lb.	.12 – .18
Lead:		
White, basic cabonate, dry, casks	lb.	.10 – .10½
White, in oil, kegs	lb.	.12½– .14
Red, dry, casks	lb.	.11½– .12
Red, in oil, kegs	lb.	.13½– .15
Lead acetate, white crys., bbl.	lb.	.13½– .14
Lead arsenate, powd., bbl.	lb.	.23 – .24
Lime-Hydrated, bbl. per	ton	16.80 – 17.00
Lime, Lump, bbl 280	lb.	3.63 – 3.65
Litharge, comm., casks	lb.	.10½– .11
Lithophone, bbl.	lb.	.06½– .07
Magnesium carb., tech., bags	lb.	.08 – .08½
Methanol, 95%, bbl.	gal.	1.23 – 1.25
Methanol, 97%, bbl.	gal.	1.25 – 1.27
Nickel salt, double, bbl.	lb.	.10 – .10½
Nickel salts, single, bbl.	lb.	.11 – .11½
Phosgene		.60 – .75
Phosphorus, red, cases	lb.	.35 – .40
Phosphorus, yellow, cases	lb.	.30 – .35
Potassium bichromate, casks	lb.	.10½– .11½
Potassium bromide, gran., bbl.	lb.	.16 – .23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 – .06½
Potassium chlorate, powd.	lb.	.07 – .08
Potassium cyanide, drums	lb.	.45 – .50
Potassium hydroxide (caustic potash) drums 100	lb.	8.25 – 8.75
Potassium iodide, cases	lb.	3.65 – 3.75
Potassium nitrate, bbl.	lb.	.06½– .07½
Potassium permanganate, drums	lb.	.25 – .27
Potassium prussiate, red, casks	lb.	.80 – .85
Potassium prussiate, yellow, casks	lb.	.37½– .38
Salammoniac, white, gran., casks, imported	lb.	.06½– .06¾
Salammoniac, white, gran., bbl., domestic	lb.	.08 – .08¾
Gray, gran., casks	lb.	.08¼– .08¼
Salsoda, bbl. 100	lb.	1.20 – 1.40
Salt cake (bulk)	ton	26.00 – 28.00
Soda ash, light, 58% flat, bags, contract 100	lb.	1.60 – 1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks. 100	lb.	1.20 – 1.30
Soda ash, light, 58%, flat, bags, resale 100	lb.	1.75 – 1.80
Soda ash, dense, bags, contract, basis 48% 100	lb.	1.17½– 1.20
Soda ash, dense, in bags, resale 100	lb.	1.85 – 1.90
Soda, caustic, 76%, solid, drums, f.a.s. 100	lb.	3.45 – 3.70
Soda, caustic, 76%, solid, drums, contract 100	lb.	3.35 3.40
Soda, caustic, basis 60% wks., contract 100	lb.	2.50 – 2.60
Soda, caustic, ground and flake, contracts 100	lb.	3.80 – 3.90
Soda, caustic, ground and flake, resale 100	lb.	4.00 – 4.15
Sodium acetate, works, bags	lb.	.06 – .06½
Sodium bicarbonate, bbl. 100	lb.	2.00 – 2.50
Sodium bichromate, casks	lb.	.07½– .08
Sodium bisulphate (niter cake)	ton	6.00 – 7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½– .04½
Sodium chlorate, kegs	lb.	.06½– .07
Sodium chloride long	ton	12.00 – 13.00
Sodium cyanide, cases	lb.	.20 – .23
Sodium fluoride, bbl.	lb.	.09 – .10
Sodium hyposulphite, bbl.	lb.	.03 – .03¼
Sodium nitrite, casks	lb.	.08½– .09
Sodium peroxide, powd., cases	lb.	.28 – .30
Sodium phosphate, dibasic, bbl.	lb.	.03½– .04
Sodium prussiate, yel. drums	lb.	.18½– .19
Sodium silicate (40°, drums) 100	lb.	.80 – 1.15
Sodium silicate (60°, drums) 100	lb.	2.00 – 2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04½– .04½
Sodium sulphite, crys., bbl.	lb.	.03½– .03¾
Strontium nitrate, powd., bbl.	lb.	.09½– .10
Sulphur chloride, yel drums	lb.	.04½– .05
Sulphur, crude	ton	18.00 – 20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 – .08½
Sulphur, flour, bbl. 100	lb.	2.35 – 3.15
Sulphur, roll, bbl. 100	lb.	$2.00 – $2.50
Talc—imported, bags	ton	30.00 – 40.00
Talc—domestic powd., bags	ton	18.00 – 25.00
Tin bichloride, bbl.	lb.	.13½– .14
Tin oxide, bbl.	lb.	.52 – .54
Zinc carbonate, bags	lb.	.14 – .14½
Zinc chloride, gran, bbl.	lb.	.06 – .07
Zinc cyanide, drums	lb.	.37 – .38
Zinc oxide, XX, bbl.	lb.	.07½– .08
Zinc sulphate, bbl. 100	lb.	2.75 – 3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.80 – $0.85
Alpha-naphthol, ref., bbl.	lb.	1.05 – 1.10
Alpha-naphthylamine, bbl.	lb.	.38 – .40
Aniline oil, drums	lb.	.16½– .17
Aniline salts, bbl.	lb.	.24 – .25
Anthracene, 80%, drums	lb.	.75 – 1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 – .70
Anthraquinone, 25%, paste, drums	lb.	.70 – .75
Benzaldehyde U.S.P., carboys	lb.	1.40 – 1.45
Benzene, pure, water-white, tanks and drums	gal.	.30 – .35
Benzene, 90%, tanks & drums	gal.	.26 – .32
Benzene, 90%, drums, resale	gal.	.33 – .35
Benzidine base, bbl.	lb.	.85 – .90
Benzidine sulphate, bbl.	lb.	.75 – .80
Benzoic acid, U.S.P., kegs	lb.	.72 – .75
Benzoate of soda, U.S.P., bbl.	lb.	.57 – .65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 – .27
Benzyl chloride, tech., drums	lb.	.20 – .23
Beta-naphthol, subl., bbl.	lb.	.55 – .60
Beta-naphthol, tech., bbl.	lb.	.24 – .25
Beta-naphthylamine, tech.	lb.	.80 – .90
Carbazol, bbl.	lb.	.75 – .90
Cresol, U.S.P., drums	lb.	.25 – .29
Ortho-cresol, drums	lb.	.24 – .26
Cresylic acid, 97%, resale, drums	gal.	1.30 – 1.40
95-97%, drums, resale	gal.	1.15 – 1.20
Dichlorbenzene, drums	lb.	.07 – .09
Diethylaniline, drums	lb.	.50 – .60
Dimethylaniline, drums	lb.	.41 – .42
Dinitrobenzene, bbl.	lb.	.19 – .20
Dinitroclorbenzene, bbl.	lb.	.22 – .23
Dinitronaphthalene, bbl.	lb.	.30 – .32
Dinitrophenol, bbl.	lb.	.35 – .40
Dinitrotoluene, bbl.	lb.	.20 – .22
Dip oil, 25%, drums	gal.	.25 – .30
Diphenylamine, bbl.	lb.	.50 – .52
H-acid, bbl.	lb.	.80 – .85
Meta-phenylenediamine, bbl.	lb.	.95 – 1.00
Michlers ketone, bbl.	lb.	3.00 – 3.50
Monochlorbenzene, drums	lb.	.08 – .10
Monoethylaniline, drums	lb.	.95 – 1.10
Naphthalene, crushed, bbl.	lb.	.08 – .09
Naphthalene, flake, bbl.	lb.	.09½– .10
Naphthalene, balls, bbl.	lb.	.10 – .10½
Naphthionate of soda, bbl.	lb.	.58 – .65
Naphthionic acid, crude, bbl.	lb.	.60 – .65
Nitrobenzene, drums	lb.	.10 – .12
Nitro-naphthalene, bbl.	lb.	.30 – .35
Nitro-toluene, drums	lb.	.15 – .17
N-W acid, bbl.	lb.	1.25 – 1.30
Ortho-amidophenol, kegs	lb.	2.30 – 2.35
Ortho-dichlorbenzene, drums	lb.	.17 – .20
Ortho-nitrophenol, bbl.	lb.	.90 – .92
Ortho-nitrotoluene, drums	lb.	.10 – .12
Ortho-toluidine, bbl.	lb.	.13 – .15
Para-amidophenol, base, kegs	lb.	1.15 – 1.20
Para-amidophenol, HCl, kegs	lb.	1.20 – 1.25
Para-dichlorbenzene, bbl.	lb.	.17 – .20
Paranitraniline, bbl.	lb.	.74 – .75
Para-nitrotoluene, bbl.	lb.	.55 – .65
Para-phenylenediamine, bbl.	lb.	1.45 – 1.50
Para-toluidine, bbl.	lb.	.90 – .95
Phthalic anhydride, bbl.	lb.	.35 – .38
Phenol, U.S.P., drums	lb.	.50 – .55
Picric acid, bbl.	lb.	.20 – .22
Pyridine, dom., drums	gal.	nominal
Pyridine, imp., drums	gal.	2.30 – 2.50
Resorcinol, tech., kegs	lb.	1.50 – 1.55
Resorcinol, pure, kegs	lb.	2.00 – 2.10
R-salt, bbl.	lb.	.60 – .65
Salicylic acid, tech., bbl.	lb.	.47 – .48
Salicylic acid, U.S.P., bbl.	lb.	.50 – .52
Solvent naphtha, water-white, drums	gal.	.37 – .40
Crude, drums	gal.	.22 – .24
Sulphanilic acid, crude, bbl.	lb.	.18 – .20
Thiocarbanilide, kegs	lb.	.35 – .38
Toluidine, kegs	lb.	1.20 – 1.30
Toluidine, mixed, kegs	lb.	.30 – .35
Toluene, tank cars	gal.	.35 – .37
Toluene, drums	gal.	.40 – .43
Xylidines drums	lb.	.40 – .45
Xylene, pure, drums	gal.	.45 – .50
Xylene, com., drums	gal.	.40 – .42
Xylene, com., tanks	gal.	.30 –

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.00 –	
Rosin E-I, bbl.	280 lb.	6.10 –	$6.15
Rosin K-N, bbl.	280 lb.	6.40 –	6.80
Rosin W.G.-W.W., bbl.	280 lb.	7.35 –	8.05
Wood rosin, bbl.	280 lb.	6.25 –	
Turpentine, spirits of, bbl.	gal.	1.53 –	1.54
Wood, steam dist., bbl.	gal.	1.35 –	
Wood, dest. dist., bbl.	gal.	1.25 –	
Pine tar pitch, bbl.	200 lb.	–	6.00
Tar, kiln burned, bbl.	500 lb.	–	12.00
Retort tar, bbl.	500 lb.	–	11.00
Rosin oil, first run, bbl.	gal.	.43 –	
Rosin oil, second run, bbl.	gal.	.47 –	
Rosin oil, third run, bbl.	gal.	.53 –	
Pine oil, steam dist.	gal.	–	.90
Pine oil, pure, dest. dist.	gal.	–	.85
Pine tar oil, ref.	gal.	–	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	–	.35
Pine tar oil, double ref., bbl.	gal.	–	.75
Pine tar, ref., thin, bbl.	gal.	–	.25
Pinewood creosote, ref., bbl.	gal.	–	.52

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$.13½–	$.13½
Castor oil, AA, bbl.	lb.	.14 –	.14½
Chinawood oil, bbl.	lb.	.25 –	.26
Coconut oil, Ceylon, bbl.	lb.	.10½–	.10¾
Coconut oil, Cochin, bbl.	lb.	.10¾–	
Corn oil, crude, bbl.	lb.	.12½–	
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½–	.10¾
Summer yellow, bbl.	lb.	.12½–	.13
Winter yellow, bbl.	lb.	.13 –	.13½
Linseed oil, raw, car lots, bbl.	gal.	1.05 –	
Raw, tank cars (dom.)	gal.	1.00 –	
Boiled, 5-bbl. lots (dom.)	gal.	1.10 –	
Olive oil, denatured, bbl.	gal.	1.10 –	1.15
Palm, Lagos, casks	lb.	.08¼–	.08¾
Palm kernel, bbl.	lb.	.09¼–	
Peanut oil, crude, tanks (mill)	lb.	.13½–	.13¾
Peanut oil, refined, bbl.	lb.	.17 –	
Rapeseed oil, refined, bbl.	gal.	.84 –	.85
Rapeseed oil, blown, bbl.	gal.	.90 –	.91
Soya bean (Manchurian), bbl.	lb.	.12½–	
Tank, f.o.b. Pacific coast	lb.	.10½–	

Fish Oils

Menhaden, light pressed, bbl.	gal.	$0.70 –	
White bleached, bbl.	gal.	.72 –	.74
Blown, bbl.	gal.	.76 –	.78
Whale No. 1 crude, tanks, coast	lb.	.06½–	

Dye & Tanning Materials

Divi-divi, bags	ton	$38.00 –	$39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½–	.03½
Sumac, leaves, Sicily, bags	ton	65.00 –	
Sumac, ground, bags	ton	55.00 –	60.00
Sumac, domestic, bags	ton	35.00 –	
Tapioca flour, bags	lb.	.03½–	.05

EXTRACTS

Archil, conc., bbl.	lb.	$0.17 –	$0.18
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	.17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½–	.05
Sumac, dom., 51°, bbl.	lb.	.06½–	.07

Waxes

Bayberry, bbl.	lb.	$0.28 –	$0.30
Beeswax, refined, dark, bags	lb.	.30 –	.32
Beeswax, refined, light, bags	lb.	.34 –	.35
Beeswax, pure white, cases	lb.	.40 –	.41
Candellila, bags	lb.	.25 –	.27
Carnauba, No. 1, bags	lb.	.40 –	.41
No. 2, North Country, bags	lb.	.23½–	.24
No. 3, North Country, bags	lb.	.19 –	.19½
Japan, cases	lb.	.14½–	.15
Montan, crude, bags	lb.	.04 –	.04½
Paraffine, crude, match, 105-110 m.p.	lb.	.04 –	.04½
Crude, scale 124-126 m.p., bags	lb.	.02½–	.03
Ref., 118-120 m.p., bags	lb.	.03½–	.03¾
Ref., 125 m.p., bags	lb.	.03¾–	.03¾
Ref., 128-130 m.p., bags	lb.	.04 –	.04¼
Ref., 133-135 m.p., bags	lb.	.04¼–	.04¾
Ref., 135-137 m.p., bags	lb.	.05 –	.05¼
Stearic acid, sgle pressed, bags	lb.	.14 –	
Double pressed, bags	lb.	.14½–	
Triple pressed, bags	lb.	.16 –	

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.30 –	$3.40
F.a.s. double bags	100 lb.	4.15 –	4.25
Blood, dried, bulk	unit	4.60 –	
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.62½–	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 –	4.80
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$4.00 –	$4.50
Tennessee, 78-80%	ton	8.00 –	8.25
Potassium muriate, 80%, bags	ton	35.00 –	36.00
Potassium sulphate, bags	unit	1.00 –	

Crude Rubber

Para—Upriver fine	lb.	$0.33 –	$0.33½
Upriver coarse	lb.	.27½–	.28
Upriver caucho ball	lb.	.29½–	.30
Plantation—First latex crepe	lb.	.34½–	.35
Ribbed smoked sheets	lb.	.34½–	.35
Brown crepe, thin, clean	lb.	.31 –	.32
Amber crepe No. 1	lb.	.31 –	.32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 –	$550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 –	80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 –	17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	15.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	28.00 –	
Barytes, crude f.o.b. mines, bulk	net ton	11.00 –	11.50
Casein, bbl., tech.	lb.	.11 –	.12
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 –	9.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	13.00 –	20.00
Crude f.o.b. Va.	net ton	8.00 –	12.00
Ground, f.o.b. Va.	net ton	13.00 –	20.00
Imp., lump, bulk	net ton	15.00 –	20.00
Imp., powd.	net ton	45.00 –	50.00
Feldspar, No. 1 pottery	long ton	6.00 –	7.00
No. 2 pottery	long ton	5.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 –	27.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06 –	.06½
Ceylon, chip, bbl.	lb.	.05 –	.05½
High grade amorphous crude	ton	35.00 –	50.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb.	1.75 –	1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N. Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Shellac, orange fine, bags	lb.	.82 –	.83
Orange superfine, bags	lb.	.84 –	.85
A. C. garnet, bags	lb.	.78 –	.79
T. N., bags	lb.	.79 –	.80
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11¾
4-6% C	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	115.00 –	120.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	38.00 –	40.00
50%	gr. ton	86.00 –	89.00
75%	gr. ton	150.00 –	165.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.85 –	$0.90
Ferro-uranium, 35-50% of U. per lb. of U	lb.	6.00 –	
Ferrovanadium, 30-40%, per lb. of V	lb.	3.75 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.50 –	$8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 –	23.00
C.i.f. Atlantic seaboard	ton	18.50 –	19.00
Coke, fdry., f.o.b. ovens	ton	8.25 –	8.50
Coke, furnace, f.o.b. ovens	ton	7.00 –	7.25
Fluorspar, gravel, f.o.b. mines' Illinois	ton	21.50 –	
Ilmenite, 52% TiO_2	lb.	.01½–	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 –	
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 –	.70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½–	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½–	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12	
Rutile, 95% TiO_2	lb.	.12 –	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.50 –	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 –	2.50
Vanadium pentoxide, 99%	lb.	12.00 –	14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 –	
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½–	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	17.375
Aluminum, 98 to 99%	25.00-25.50
Antimony, wholesale, Chinese and Japanese	8.75–9.00
Nickel, virgin metal	25.00–27.00
Nickel, ingot and shot	29.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	48.625
Lead, New York, spot	8.25
Lead, E. St. Louis, spot	8.25
Zinc, spot, New York	7.90–8.10
Zinc, spot, E. St. Louis	7.65–8.00

OTHER METALS

Silver (commercial)	oz.	$0.67¼
Cadmium	lb.	1.10
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	2.65@2.85
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	110.00
Iridium	oz.	260.00@275.00
Palladium	oz.	79.00
Mercury	75 lb.	69.00@70.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11 25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.14

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

ACIPCO—The American Cast Iron Pipe & Foundry Co. will rebuild the portion of its testing department, destroyed by fire, March 8. An official estimate of loss has not been made.

Arizona

PHOENIX—The Riverside Portland Cement Co., Riverside, Calif., has tentative plans under consideration for the construction of a new cement plant in the vicinity of Phoenix, estimated to cost in excess of $750,000, including machinery. Harry Welch, secretary of the Phoenix Chamber of Commerce, is co-operating with the company in connection with site selection. Loren Barton is assistant general manager.

California

MCPHERSON—The Orange Belt Oil Refining Co., McPherson, near Orange, will commence the immediate erection of a new local refinery, estimated to cost $55,000.

ANTIOCH—The Paraffine Companies, Inc., 34 1st St., San Francisco, has awarded a contract to Fred Stamm, 25 A St., Antioch, for the erection of its proposed new 1-story plant addition, estimated to cost $40,000. Leland Rosener, Insurance Bldg., San Francisco, is architect.

SAN DIEGO—The Vitrified Products Co. is completing plans for the construction of a new plant on site at Old Town, near San Diego, totaling 17 acres, for the manufacture of vitrified brick. It will be equipped for an initial output of 50,000 bricks daily. The company has extensive clay deposits in the vicinity of Linda Vista. Victor Kremer is president.

MARICOPA—The Pacific Midway Oil Co. which heretofore has had a topping plant in operation on its property, is expanding its operations and installing a new separate "jitney refinery" unit for a complete rundown of its crude. H. F. Everard and E. D. Goldsmith are the designers and E. D. Goldsmith has charge of the construction.

ONTARIO—The Interlocking Tile & Sewer Pipe Co. is considering the construction of a local plant for the manufacture of special burned clay products. The purchase of an extensive tract of land at Indio, in the same district, is planned, to be used for raw material supply. J. F. Gale and D. E. Bulger represent the company in connection with the project. B. W. Spencer, secretary of the Ontario Chamber of Commerce, is interested in the new plant.

SUNNYVALE—The Sunnyvale Concrete Products Co. has commenced the erection of an addition to its plant, to be equipped for the manufacture of concrete pipe. It will cost about $15,000.

LOS ANGELES—A 1-story foundry addition, 40x100 ft., will be erected at the plant of the Union Tool Co., Torrance, near Los Angeles, for iron casting production.

Connecticut

WATERBURY—The Connecticut Brass Foundry Co., 660 East Main St., will build a new addition to its plant, 1-story, 25x40 ft. Henry F. Wenzel, Waterbury, is architect.

Illinois

CHICAGO—The Alberene Stone Co., 214 North Clenton St., manufacturer of soapstone products for domestic and other service, has purchased the plant of the United States Industrial Alcohol Co., Elston and Wabansia Aves., 100x150 ft., improved with a 1- and 2-story building. The property was acquired for a consideration of $45,000, and will be used by the new owner for its plant. The present works will be removed to the location and a number of extensions made.

Indiana

INDIANAPOLIS—The Lilly Varnish Co., 670 South California St., has filed plans for a 1-story factory addition.

BROOKLYN—The Brooklyn Brick Co. has work under way on improvements in its plant to include the construction of new down-draft kilns, and the installation of considerable equipment. It is proposed to establish a department for the manufacture of face brick. The common brick output will be maintained on a basis of 60,000 bricks per day.

Kansas

EMPORIA—The Common Council is completing plans for extensions and improvements in the municipal waterworks, to include the installation of a new chlorinator and other equipment. E. T. Mendel is clerk.

Kentucky

LOUISVILLE—The Louisville Gas & Electric Co. has purchased a 70-acre site for the construction of a new artificial gas plant. The structure will be arranged in a series of individual units, capable of expansion as desired, estimated to cost more than $5,000,000. Plans for the first unit will be prepared and work placed in progress at an early date. Donald McDonald is vice-president.

PADUCAH—The Tucker Chemical Mfg. Co., recently organized with a capital of $250,000, has tentative plans under consideration for the establishment of a local plant for the manufacture of chemical products for the textile industry, as well as other service. The new company is headed by E. C. Pace, W. C. Richman and T. A. Miller.

CHINNVILLE—The Kentucky Refractories Corp., Ironton, Ky., has plans under way for the construction of a local plant for the manufacture of firebrick, refractory linings and other refractories. A 12-acre site has been acquired for the plant, which is estimated to cost $80,000, with machinery. C. K. Turtley is president.

Louisiana

NEW ORLEANS—Godchaux Sugars, Inc., 527 Canal St., has abandoned plans for the rebuilding of its refining plant at Elm Hall, destroyed by fire several months ago, and will enlarge its Reserve and Raceland refineries to make up the necessary capacity. Work will be commenced at once on an addition to the first noted plant, and considerable new machinery will be installed.

WEST BATON ROUGE—The Glynn Planting Co., operating the local Kelson plant for the manufacture of sirups, is planning for the erection of an addition to be equipped as a sugar refinery. Work will be commenced at an early date.

Maryland

BALTIMORE—Johns Hopkins University has filed plans for the immediate erection of its proposed new chemical laboratory at Charles St. and the University Parkway, to be 3-story, 148x160 ft., estimated to cost about $400,000. Contract for the work was awarded recently to the Consolidated Engineering Co., Calvert Bldg.

Massachusetts

ROCKPORT—The Board of Selectmen has plans under consideration for the installation of a filter system at the municipal waterworks. John Dennis is head of the board.

EAST BOSTON—The East Boston Pottery Co. is planning for enlargements in its plant, including the installation of additional equipment and three new kilns. Work will be placed under way at an early date.

WESTFIELD—The H. B. Smith Co. is planning for the early erection of a new 1-story foundry at its local boiler-manufacturing plant, to be equipped for the production of iron castings. Monks & Johnson, 99 Chauncey St., Boston, are engineers.

WATERTOWN—The Hood Rubber Co., Nichols Ave., is completing the erection of a 3-story addition to its tire and rubber plant, 64x128 ft., and plans for the installation of machinery at an early date. The Aberthaw Construction Co., 27 School St., Boston, is the general contractor. F. C. Hood is general manager.

Michigan

ESCANABA—The Universal Magnesite Products Co., recently organized, has leased a local building and will commence the immediate installation of machinery for the manufacture of composition materials for construction service, magnesite stucco, wall plaster and affiliated products. L. K. Edwards is president; and P. L. Sullivan, vice-president and general manager.

MUSKEGON—A 1-story foundry, 120x220 ft., estimated to cost about $175,000, will be constructed at the plant of the Piston Ring Co., to be used for the production of steel castings.

ONTONAGON—The Ontonagon Fiber Co., now being organized, has taken over the former local plant of the Northern Fiber Co., temporarily abandoned in 1921. The mill is designed for the manufacture of unbleached soda pulp, and will be remodeled by the new owner for the production of bleached and unbleached sulphate pulp and soda pulp. Equipment will be installed for a daily capacity of about 75 tons of material, and it is expected to have the plant ready for service before the close of the year. D. Clark Everest, one of the heads of the Ewing-Everest Pulp Co., Merrill, Wis., and secretary and general manager of the Marathon Paper Co., Rothschild, Wis., is one of the principal organizers of the new Ontonagon company.

New Jersey

FORDS—The Fords Art Stone Co., Inc., has commenced the erection of a new 1-story plant addition, and plans for the installation of additional equipment.

NEWARK—The Metal Products Co., 134 Lafayette St., is arranging for the immediate rebuilding of the portion of its lacquer department, damaged by fire, march 12. An official estimate of loss has not been made.

NEWARK—J. Hague Armitage & Sons, Inc., Thomas and Dawson Sts., manufacturer of waterproofing products, coated specialties, etc., has acquired the vacant plot of land, 100x225 ft., at Dawson and Parkhurst Sts., in the vicinity of its plant, for proposed future additions.

New York

NIAGARA FALLS—The Pittsburgh Metallurgical Co., Highland Ave., is planning for the rebuilding of the portion of its plant, destroyed by fire, March 12.

GLEN PARK—The National Paper Products Co., Carthage, N. Y., has negotiations in progress for a lease of the C. R. mill of the International Paper Co., located at Glen Park. It is purposed to improve the plant upon acquisition, with the installation of equipment for the manufacture of tissue and other papers.

ITHACA—Cornell University is planning for the rebuilding of the portion of the laboratory of the Sibley College of Engineering, destroyed by fire March 13, with loss estimated at $10,000.

BALSTON SPA—The Adirondack Paper Corp., recently organized, has leased the local mill of the Island Paper Co. for a new plant, and will take immediate possession. Improvements will be made and necessary equipment installed. The company is headed by F. B. Oldham, Newtonville; B. G. MacDonald, Albany; and L. C. Case, Guilderland.

North Carolina

KERNERSVILLE—The American Iron Works, P. O. Box 138, recently formed with a capital of $75,000, is planning for the erection of a 1-story foundry in connection with its proposed local plant, to be equipped for the manufacture of iron castings. A 2-ton cupola will be installed. O. L. Smith is secretary.

Ohio

COSHOCTON—The Pope Gosser China Co. will soon commence the erection of an addition to its plant to cost about $25,000.

Oklahoma

ARDMORE—The Monterey Glass Co., Monterey, Mex., is considering plans for the construction of a branch plant at Ardmore. A site is being selected in the vicinity of glass sand properties.

Oregon

PORTLAND—The Astoria Brick & Building Material Co. has purchased a portion of the former property of the Northern Pacific Brewing Co., and plans for the erection of a new brick-manufacturing plant, with initial capacity of 65,000 bricks daily. The main building will be 100x200 ft.

Pennsylvania

HARRISBURG—The Harrisburg Gas Co. is planning for extensions and improvements in its artificial gas plant, to include the installation of new compressors and other machinery.

CORAOPOLIS—The Vulcan Refining Co., is planning for the rebuilding of the portion of its local oil refinery and byproducts plant, destroyed by fire, March 12, with loss estimated at close to $60,000, including machinery. The wax plant was destroyed. Thomas Allen is general manager.

READING—The Consumers' Gas Co., a subsidiary of the United Gas Improvement Co., Broad and Arch Sts., Philadelphia, has purchased additional property at Willow Grove, as a site for the construction of a new artificial gas plant.

PITTSBURGH—The Federal Enameling & Stamping Co., McKees Rocks, has plans in progress for the rebuilding of the portion of its plant, destroyed by fire, March 12, with loss estimated at $250,000, including buildings and machinery.

South Carolina

GREENWOOD—The J. W. Sprole Oil Co. is considering plans for the rebuilding of the portion of its local plant, recently destroyed by fire. An official estimate of loss has not been made.

Tennessee

GALLATIN—The Gillespie Oil Corp. is planning for the installation of additional machinery at its local oil refinery. The capacity will be increased.

MEMPHIS—The Railway Paint Products & George M. Tagg Paint Companies, Consolidated, Inc., recently formed by a merger of the two local companies of names noted, is planning for the installation of additional machinery at its plant for large increase in output. George M. Tagg heads the company.

LEWISBURG—The City Council is considering plans for the installation of a new filtration plant at the municipal waterworks.

Texas

ELECTRA—The Griswold Oil Co. will soon commence the construction of a new refining plant, with daily capacity of about 2,500 bbl., estimated to cost close to $500,000, with machinery. A gasoline refinery will also be built, costing approximately $100,000, with "cracking" machinery and other operating equipment.

EASTLAND—The Arab Gasoline Co. has plans in progress for the construction of a new gasoline refinery, with daily capacity of 10,000 gal., estimated to cost approximately $150,000, with machinery.

WHITE CASTLE—L. N. Folse, operating a sugar cane mill, is planning for the installation of new crushing machinery and other equipment.

DALLAS—The Dallas Refining Co., recently incorporated with a capital of $175,000, has purchased property on the West Dallas Pike for the construction of a new gasoline refinery. An oil-refining plant will also be erected, with initial daily production approximating 1,000 bbl. The installation is estimated to cost about $150,000. O. F. Kullenberg heads the company.

ABILENE—R. K. Wooten, Chickasha, Okla., and R. M. Simmons, Sweetwater, Tex., have organized a company to construct and operate a local cotton oil mill. Plans will be prepared and work placed in progress at an early date. The plant is estimated to cost $350,000, with machinery.

AUSTIN—J. W. Hassell, formerly chief of the gas and oil division of the State Railroad Commission, is at the head of a new company which purposes to construct and operate a plant in Stephens County for the production of carbon black, utilizing residue natural gas from casinghead gasoline plants. The initial installation is estimated to cost $300,000, with machinery. It will be located in the vicinity of Breckenridge.

FORT WORTH—The General Foundry Co., lately organized, has acquired property at 607 North Main St., and plans for the immediate installation of equipment for the production of grey-iron castings. B. N. Wadley is president, and T. H. Stewart, secretary-treasurer.

Virginia

RICHMOND—The Standard Paper Mfg. Co., Hull and Canal Sts., has awarded a contract to the Wise Granite & Construction Co., American Bank Bldg., for the erection of a 2-story plant addition, 64x110 ft., to cost about $35,000. M. E. Wright, American Bank Bldg., is architect.

RICHMOND—The Southern Crockery Co. is planning for the rebuilding of the portion of its plant, recently destroyed by fire with loss of about $25,000. F. F. Socoloff is president.

Vermont

RUTLAND—The Rutland Fire Clay Co. has plans under consideration for the erection of an addition to its plant on Curtis Ave., including the installation of additional equipment.

West Virginia

KEYSER—The City Council is perfecting plans for the installation of a new filtration plant at the municipal waterworks, estimated to cost about $90,000. L. D. Warner is city clerk.

FAIRMONT—The Consolidation Coal Products Co. will soon commence the installation of a byproducts coke plant at its local properties.

Canada

MERRITTON, ONT.—The Garden City Paper Mills, Ltd., St. Catherines, specializing in the production of tissue and light-weight papers, is planning for the early erection of a new mill at Merritton. L. H. Gardner is president.

Industrial Developments

CERAMIC—The Colfax Drain Tile Co., Colfax, Ind., is planning to resume production within the next few weeks. The works have been idle for about 3 years past.

The Hocking Valley Products Co., Columbus, O., manufacturer of brick and hollow tile, is arranging for immediate increase in production, and will place the plant on a capacity basis.

Due to natural gas scarcity in the East Liverpool, O., district operations have been curtailed at a number of the general ware plants during the past few weeks. Orders on hand are said to warrant maximum output, and resumption on full schedule will be carried out as soon as fuel is available.

The Mid-Continent Clay Co., Peru, Kan., will devote its entire production to roofing tiles and purposes to develop a maximum output in this line. The manufacture of face brick will be discontinued.

The Acme Brick Co., Forth Worth, Tex., is running full at its plants at Denton, Millsap and Bennetts. A portion of the output is devoted to firebrick and special molded shapes. The plants have a gross output of 45,000,000 bricks per year. The present schedule will be maintained for an indefinite period.

The Hazleton Brick Co., Hazleton, Pa., has arranged for the immediate resumption of operations at its plant, and will run on a full capacity schedule until further notice. Recent orders aggregate close to 1,000,000 bricks for immediate delivery. A full working force will be employed.

PAPER—The Flower City Tissue Mills, Scottsville, N. Y., is arranging for the resumption of production at an early date, and will make a number of improvements in plant and machinery. The mill has been closed for more than 12 months past.

The St. Lawrence Paper Mills, Ltd., Three Rivers, Que., will soon start the second machine at its mill. The first paper machine at the plant is now in full operation. The working force will be increased.

Paper mills in Wisconsin are increasing production, and the majority are giving employment to full working forces. Orders on hand are said to insure capacity for several months to come.

The Grass Fibre Pulp & Paper Co., Leesburg, Fla., is maintaining full operations at its new local mill, which was placed in service early in February. The bulk of production is devoted to newsprint, utilizing saw-grass as raw material. The working force will be advanced.

The Provincial Paper Mills, Ltd., Port Arthur, Ont., has commenced operations at its new local mill and will gradually advance production. A large working force is being employed. The plant will be devoted to the manufacture of fine papers.

CEMENT—The Lehigh Portland Cement Co., Allentown, Pa., is pushing construction on its new mill at Tarrant City, Ala., and expects to have the plant ready for operation late in May. The company is maintaining active production at its Lehigh Valley mills.

The Atlas Portland Cement Co. is running full at its large mill at Northampton, Pa., with regular working force, and will maintain this schedule for an indefinite period.

The International Cement Co., Kansas City, Mo., is advancing production at its different mills. Plans are being perfected for early enlargements in the plant of the Bonner Portland Cement Co., Bonner Springs, Kan.

The Phoenix Portland Cement Co., Nazareth, Pa., is making ready for early operations at its new plant at North Birmingham, Ala., and it is expected to have the unit running full within 60 days. The plant was originally scheduled to commence manufacture in June. It has a rated capacity of more than 1,000,000 bbl. per year. The company is maintaining full operations at its Nazareth plant.

GLASS—The Inland Glass Co., Chicago, Ill., specializing in the production of illuminating glassware, is advancing operations at its new local plant at 6101 West 65th St. The factory was placed in operation about the middle of February. The working force will be increased.

The American Plate Glass Co., James City, Pa., recently acquired by the Durant Motor Co., is giving employment to about 500 operatives on a full time basis. Wages have been advanced 10 per cent since the acquisition of the property by the Durant interests.

Window glass plants in Western Pennsylvania are running at maximum capacity, with heavy orders on hand to insure this schedule for a number of months to come. Plate glass plants also report an unprecedented demand for material and are giving employment to every available worker.

The National Plate Glass Co., Blairsville, Pa., an interest of the Fisher Body Co., Detroit, Mich., manufacturer of automobile bodies, is running at full capacity with full working force, and will keep to this schedule indefinitely. Employees have been given an advance in wages, averaging about 6 cents an hour.

IRON AND STEEL—The Stewart Furnace Co., Cleveland, O., is making ready to blow in its stack at Sharon, Pa., at an early date.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., is preparing its old Oxmoor furnace for the torch, and expects to blow in the unit at an early date.

The McKeefrey furnace, Leetonia, O., is planning to go into blast at an early date. The unit has been made ready for service.

The Jones & Laughlin Steel Corp., Pittsburgh, Pa., has all of its blast furnaces on the active list, and purposes to maintain this schedule for an indefinite period.

The Woodward Iron Co., Birmingham, Ala., will soon place its second blast furnace in operation at Vanderbilt. The unit has been repaired and made ready.

The Reliance Coke Co., Youngstown, O., will blow in its Ella furnace in this district at once. The stack has been idle for about 36 months.

Steel ingot and pig-iron production in the Pittsburgh, Pa., district is exceeding the best war-time records. Every furnace now on the active list will be continued in blast for several weeks to come.

The East Rolling Mills, Inc., Baltimore, Md., specializing in the manufacture of steel sheets, is running at maximum capacity, and will adhere to this schedule for many weeks to come.

Twenty of the thirty steel mills of the Carnegie Steel Co., at Farrell, Pa., were forced to curtail operations for 3 days during the past fortnight owing to shortage of raw materials. Resumption has now been effected. Employment is being given to full working forces.

MISCELLANEOUS—The Sinclair Consolidated Oil Corp., New York, is running full at its East Chicago, Ind., refinery and breaking previous production records.

Glazed kid tanneries at Wilmington, Del., are being forced to curtail manufacture due to a shortage of raw skins from China.

Coke plants in the vicinity of Connellsville, Pa., are running at maximum capacity, and the highest production record during the past 3 years is being made on a basis of 250,000 to 260,000 tons weekly.

The Tennessee Copper & Chemical Corp., 61 Broadway, New York, is maintaining capacity production at its sulphuric acid plants in different parts of the country.

Manufacturers' Catalogs

THE RUGGLES-COLES ENGINEERING CO., New York, in a 4-page bulletin covers the principles of operation of the various types of Ruggles-Coles driers, and gives information on drying problems in a concrete way so as to save time and yet present facts which are of particular importance to engineers and allow them to get preliminary information, at least, on the class of drier they would require for the particular problem at hand.

THE MINE SAFETY APPLIANCES CO., Pittsburgh, Pa., has issued a new circular describing the Burrell Gas Mask for the commercial needs in the chemical, dye, paint, paper, etc., industries. It describes the various types of masks for various gases. There has also been published by the same company a circular describing particularly the Burrell Ammonia Gas Mask.

THE DELAVAL STEAM TURBINE CO., Trenton, N. J., has issued a folder on De Laval equipment for the Marquette Cement Co. and another on equipment in the Crown Willamette Paper Mill. It has also published two bulletins. "Plants and Products" is the title of one booklet, which briefly describes the single- and multi-stage steam turbines, centrifugal pumps, blowers and compressors, and speed-reducing gears in which that concern has specialized since its establishment in 1901. The other booklet is on small single-stage centrifugal pumps for motor or belt drive. These pumps are made in 1½- and 2-in. sizes, and are designed for capacities ranging from 5 gal. per minute against 10 ft. head up to 130 gal. per minute against 150 ft. head. They contain few and simple parts, which are manufactured to limit gages to insure interchangeability. The booklet gives complete tables and instructions for selecting pumps for different conditions, and explains how to determine the proper speeds and how to select piping, valves, fittings and driving pulley or motor to secure an efficient and satisfactory installation.

THE INTERNATIONAL COMBUSTION ENGINEERING CORP., New York, in a condensed pamphlet describes all its products.

SKINNER, SHERMAN & ESSELEN, INC., 248 Boylston St., Boston, 17, Mass., has issued a booklet entitled "An Introduction: Mr. Banker, Meet Old Man Chemistry." This is a reproduction of an article by James H. Collins, published in a recent issue of *Forbes' Magazine*.

H. S. B. W.-COCHRANE CORP., Philadelphia, Pa., has issued a booklet entitled "Feed Water Heaters in Their Relation to Steam Plant Efficiency." It informs us that "The text matter is not primarily descriptive of apparatus, but rather a presentation of the theory and practice of boiler feed water heating. After showing that the most efficient steam cycle is the one in which the feed water is heated from hot well temperature to boiler temperature by the use of steam withdrawn during expansion, various practical forms of apparatus and their uses are taken up, including vacuum deaërating heaters, back pressure heaters, heaters in conjunction with make-up water evaporators, feed-water heating by stages, different methods of control for obtaining continuous heat balance, heaters in connection with exhaust steam heating systems, heaters in conjunction with hot water heating and service systems, including heaters operated at temperatures below 212 deg. F., combined heaters and softeners and combined heaters and feed water meters. The feed water temperature best for plant efficiency is not a sharply defined quantity, as it is found that the temperature can vary through quite a wide range without seriously affecting overall economy. With the vacuum deaërating type of heater, this becomes entirely practicable—that is, the temperature of the feed water rises and falls according to the relative supplies of condensate and auxiliary exhaust steam or bled steam, without requiring close control by the attendant. The pamphlet should be of lively and timely interest to designers, managers and operators of steam plants."

THE LOUIS ALLIS CO., Milwaukee, Wis., has issued Bulletin 406, describing and giving full information with regard to the L-A, Type H. D., heavy duty motor.

THE ALEXANDER MILBURN CO., Baltimore, Md., calls attention to a miniature catalog covering the Milburn line of welding and cutting equipment, ranging from the smallest torch to a large compressing plant. Copy will be supplied upon request.

DOMESTIC LAUNDRY EQUIPMENT CORP., New York City, announces a new catalog illustrating and describing superdrying equipments for extracts, logwood, fustic, gambier, etc., vegetables, fruit and foods (dehydrating), aniline dyes and pigments, papier-mache forms and products, oxblood and packing house materials, drug extracts, candy, glue, silks, enamels, white lead, etc.

HERMAN A. HOLZ, New York City, is distributing a catalog entitled "The Holz Thetascope," which describes an apparatus for the reliable and convenient measurement of the characteristic "angle of contact" ("theta") between liquids and solids and is particularly useful for the determination of the "lubricating efficiency" of oils and greases based upon their adhesive forces to metal surfaces.

THE FULTON CO., Knoxville, Tenn., in a 16-page booklet illustrates and describes Sylphon temperature regulators for automatically and accurately regulating temperature of liquids.

New Companies

THE MONROE PAPER CO., Monroe, Mich., has been incorporated with a capital of $50,000, to manufacture paper specialties. The incorporators are E. A. Mitchell, Toledo, O.; and Frank L. A. Mitchell, 311 South Washington St., Monroe.

STANHOPERS' CHEMICAL LABORATORIES, INC., Brooklyn, N. Y., care of E. A. Deutschman, 44 Court St., Brooklyn, representative, has been incorporated with a capital of $15,000, to manufacture chemical products. The incorporators are C. G. Unger, M. Kupfer and M. L. Nathanson.

THE GENERAL PRODUCTS CO., 306 South Sharp St., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture laboratory glassware and other laboratory products. The incorporators are Roland R. and Edward W. Harmon, and O. R. Benson, Jr.

THE CENTURY VARNISH REMOVER CO., 3830 Indiana Ave., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture chemical and affiliated specialties. The incorporators are John Stone, P. C. Pack and Frank Tomsak.

THE BIG STONE GAP BRICK & TILE CO., INC., Big Stone Gap, Va., has been incorporated with a capital of $100,000, to manufacture brick, tile and other burned clay products. The incorporators are W. W. and I. C. Taylor, Big Stone Gap, who will act as president and secretary, respectively.

THE FIRE ZONE LUBRICATING CO., College Point, L. I., care of Guernsey & Guernsey, Jamaica, L. I., representatives, has been incorporated with a capital of $20,000, to manufacture oil products. The incorporators are T. H. Doremus, G. S. Miller and G. V. Guernsey.

THE RAJAH CHEMICAL CO., Philadelphia, Pa., has been incorporated with a capital of $110,000 to manufacture chemicals and chemical byproducts. L. H. Gerhold, 668 North 19th St., Philadelphia, is treasurer and representative.

THE SOUTHWEST TANNING CO., Springfield, Mo., has been incorporated with a capital of $100,000, to manufacture leather products. The incorporators are W. R. Wolfe, E. M. Mitchell and W. E. Ogston, all of Springfield.

THE REUTHER FOUNDRY CO., Harrison, N. J., has been incorporated with a capital of $500,000, to manufacture gray iron castings. The company will take over the foundry heretofore operated under the name of Reuther Brothers, 7th and Bergen Sts. The incorporators are Frank, Frederick and Francis Reuther.

THE KORNOFF CHEMICAL CO., 22 West Quincy St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are Morris Honorof, S. Ruthstein and George J. Teller.

THE BUCKEYE TILE CO., York, Pa., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated with a capital of $650,000, under Delaware laws, to manufacture tile and other ceramic products. The incorporators are M. W. Elesser, C. J. Grove and J. C. Strayer, York.

THE MAJOR OIL & REFINING CO., Indianapolis, Ind., has been incorporated with a capital of $100,000, to manufacture refined petroleum products. The incorporators are Fred Cline, E. E. Perry and John Elliott, all of Indianapolis.

THE CHESTER BRICK CORP., Chester, Pa., has been incorporated with a capital of $50 000, to manufacture brick, tile and other burned clay products. Edward C. Burton, 415 East 13th St., Chester, is treasurer and representative.

Coming Meetings and Events

AMERICAN ASSOCIATION OF CEREAL CHEMISTS will hold its ninth annual convention at Hotel Sherman, Chicago, June 4 to 9.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN GAS ASSOCIATION will hold its annual convention the week of Oct. 15 at Atlantic City. An elaborate exhibition of gas-making and gas-utilization equipment is planned.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting June 20-23 at Wilmington, Del.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Eastman Hotel, Hot Springs, Ark., April 30 and May 1.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting May 28 to 31 in Montreal, Canada.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

CANADIAN INSTITUTE OF CHEMISTRY will hold its annual meeting in Toronto, May 29 to 31.

ENGINEERING SECTION of the National Safety Council will hold a mid-year safety conference April 17 in the auditorium of the Western Society of Engineers.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL ASSOCIATION OF MANUFACTURERS OF THE UNITED STATES OF AMERICA will meet in annual conference May 14 to 16, inclusive, at the Waldorf-Astoria, New York City.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (NINTH) will be held in New York Sept. 17-22.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NATIONAL LIME ASSOCIATION will hold its fifth annual convention at the Hotel Commodore, New York City, June 13 to 15.

NATIONAL SYMPOSIUM ON COLLOID CHEMISTRY will be held at the University of Wisconsin, June 12 to 15.

SOCIETY OF CHEMICAL INDUSTRY, Canadian Section, will meet in Toronto, May 29 to 31.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY FOR STEEL TREATING — Eastern sectional meeting will be held June 14 and 15, in Bethlehem, Pa.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City; April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8 — American Chemical Society, regular meeting.